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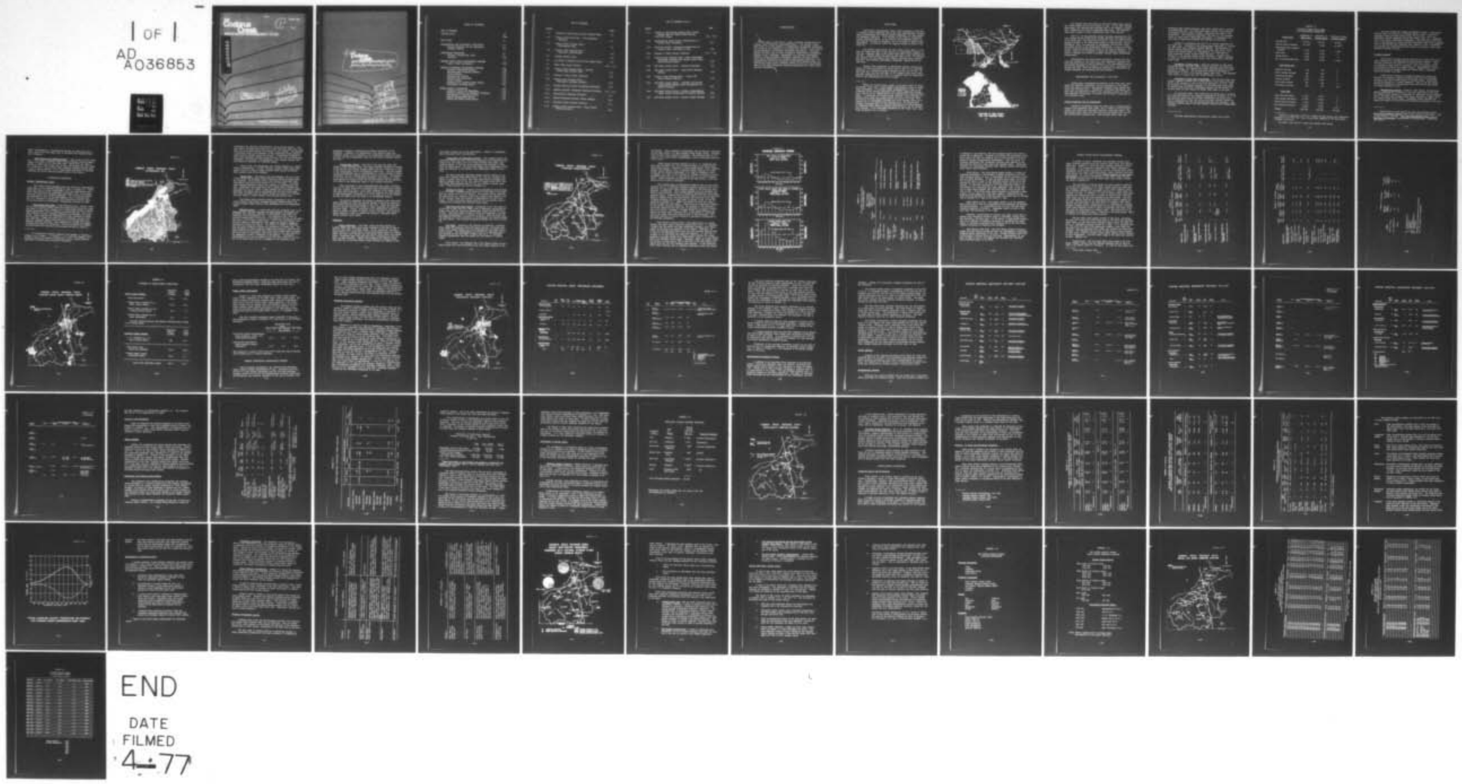

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THE Codorus Creek WASTEWATER MANAGEMENT STUDY

APPENDIX A – TECHNICAL STUDIES – VOLUME I

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Codorus Creek

WASTEWATER MANAGEMENT STUDY.

APPENDIX A. TECHNICAL STUDIES. VOLUME I.

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INTRODUCTION

This report is the first of a group of reports encompassing the Codorus Creek Wastewater Management Study. The purpose of this first report is to bring together a comprehensive background understanding of factors and conditions in the Study Area germane to the analysis and development of wastewater management alternatives. The report defines the study area in terms of physical characteristics (geography, geology, soils, hydrology), demographic and economic development, sources of waste discharge, wastewater treatment facilities present, water supply development and resultant water quality conditions. Assessments are made of the causative relationships between waste discharges and water quality conditions which are critical to the development of long range wastewater treatment alternatives and overall water resources management.

STUDY AREA

York County, Pennsylvania, with a 1970 population of 272,603, is located in the southeastern part of the state approximately 100 miles west of Philadelphia and midway between Harrisburg, the state capitol, and Baltimore, Maryland. It is bounded on the north by Cumberland County (Harrisburg West), on the east by the Susquehanna River, on the south by the State of Maryland, and on the west by Adams County (Gettysburg). Its location within the regional setting is shown in Exhibit I-1.

The Codorus Creek Basin, the main focus of this study,[1] occupies the middle one-third of York County, as illustrated in Exhibit I-1, and has a drainage area of 280 square miles with a 1970 population of 156,500. Located within this basin are the City of York, its surrounding suburbs, and the larger of the outlying urbanized areas: Hanover, Red Lion, New Freedom, Shrewsbury, Dallastown, Spring Grove and Glen Rock.

Codorus Creek originates as three major branches (whose subbasins are shown in Exhibit I-1) which flow in more or less northerly directions to a confluence located southwest of the City of York. At this point they form the Main Stem of the Codorus which flows northeasterly, through the City of York, to a junction with the Susquehanna River in the northeastern part of the County.

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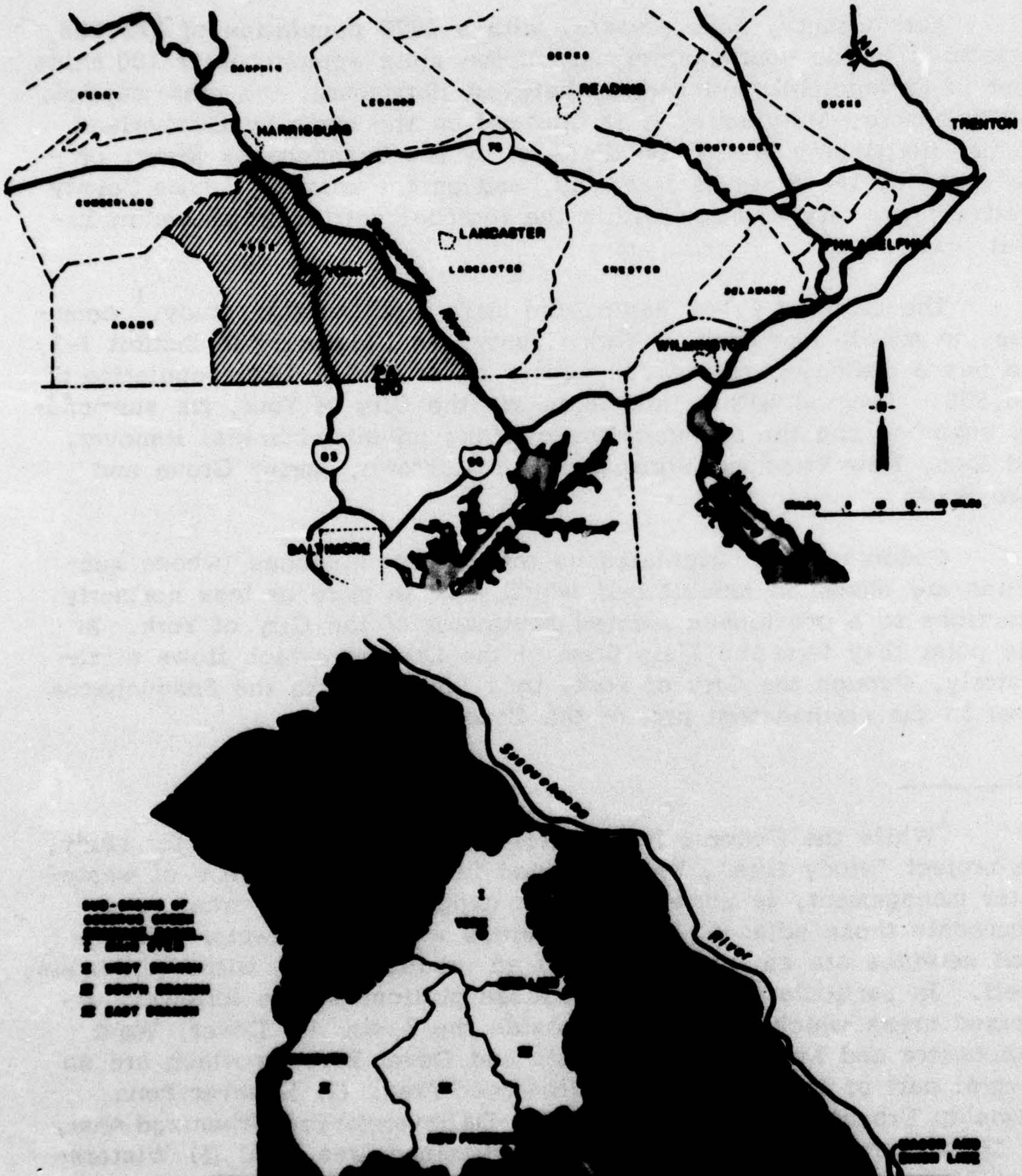
[1] While the Codorus Basin, itself, is the major focus for study, the project "study area", being defined functionally in terms of wastewater management, is somewhat larger geographically in order to accommodate those adjacent urbanized areas whose wastewater management services are an integral part of an urbanized area within the basin, itself. In particular, the study includes portions of the following urbanized areas which are located outside the Basin: (1) Dover, West Manchester and Manchester Township and Dover Borough which are an integral part of the Greater York Urbanized Area, (2) Hanover-Penn Township Urbanized Area, (3) Red Lion-Dallastown-Yoe Urbanized Area, (4) Shrewsbury-New Freedom-Railroad Urbanized Area, and (5) Winterstown Borough. In all subsequent references to the "study area", this larger geographic area is implied.

EXHIBIT I-1



LOCATIONS OF YORK COUNTY
AND THE CODORUS BASIN

The Greater York Area serves as the major urban focal point for the Codorus Basin and for York County as well. Of the other outlying urban areas, the Hanover-Penn Township Area is the largest in population, followed by the Red Lion-Dallastown-Yoe Area. The remaining urban areas consist of small communities under 2,000 persons.

The U.S. 30 transportation corridor (running east-west) and the I-83 corridor (running north-south) provide the major development axes of the study area. The former has historically been the east-west transportation corridor in the Southeastern portion of Pennsylvania, linking Gettysburg, York, and Lancaster to Philadelphia and the East Coast. The latter, known as the Susquehanna Expressway, is part of a larger corridor linking the Susquehanna Valley to the coast at Baltimore. York County, being at the crossroads of these two important corridors, occupies a strategic and readily accessible location within Southeastern Pennsylvania.

Manufacturing and retail-service industries comprise the major economic activities in the study area with agriculture, extractive and other industries being of lesser importance. The manufacturing and retail-service industries are located in the urban areas, particularly the Greater York Area, while the extractive industries and agriculture are located throughout the remaining non-urban portions.

DEMOGRAPHIC AND ECONOMIC CONDITIONS

Turning from a introductory description of the study area, population and economic development are now considered in more detail. These two topics are part of the overall framework which defines the study area resources base. Furthermore, wastewater management systems must be understood in light of the population served (in terms of both magnitude and location of service) and the types of economic activity served as well.

Present Population and Its Distribution

Population distribution within the study area is characterized by several multi-community urban nodes, and a number of outlying incorporated, but stable and compactly developed, semi-urban areas. The major urban nodes within the study area are the Greater York Area and the Hanover-Penn Township Area. The remaining urban nodes are:

Shrewsbury-New Freedom-Railroad, Glen Rock, Spring Grove, and Red Lion-Dallastown-Yoe. The semi-urban areas consist of the Boroughs of Jefferson, Seven Valleys, Jacobus, Loganville, New Salem, and Winterstown. The remaining population, that which is not contained within an urban node or semi-urban community, is considered to be rural and is distributed throughout the remainder of the basin.

Exhibit I-2 summarizes the 1970 U. S. Census population for the study area. Compared to the Codorus Basin population of 156,497, the 1970 study area population totaled 193,399. The difference of 36,902 persons reflects that portion of the study area which, while outside the Codorus Basin, is, nevertheless, an integral part of those population centers located within the basin. As seen from Exhibit I-2, the greatest portion of this difference or 33,377 persons, is within the Greater York Urban Node or the Hanover-Penn Township Urban Node.

Population of urban nodes - With the exception of Glen Rock and Spring Grove, the urban nodes contain population both within and outside the basin. The Greater York Urban Node dominates the entire population of 193,399. The Hanover-Penn Township population of approximately 29,000[1] is the second largest urban node. The remaining urban nodes all contain less than 17,000 persons in total.

Population of semi-urban communities - The six semi-urban communities together comprise only a minor portion of the Basin population (about 4,200 persons or 2.5% of the Basin population in 1970). With the exception of Winterstown Borough, all the semi-urban communities lie wholly within the basin; Winterstown Borough lies half within the Codorus Basin and half within the Muddy Creek basin to the east.

As previously noted, York County and the study area in question lie at the crossroads of two important transportation corridors, U. S. 30 (the historical east-west link between Philadelphia and points west) and the Susquehanna Valley (the major north-south corridor linking the coast at Baltimore with the Pennsylvania and New York interiors). Development patterns prior to the past decade followed these transportation corridors.

[1] Includes approximately 5,000 persons outside York County.

EXHIBIT I-2

CODORUS CREEK STUDY AREA
1970 POPULATION STATISTICS[a]

Urban Node	Population in Study Area	Population in Codorus Basin	Population Outside Codorus Basin
Greater York	117,681	104,181	13,500
Hanover-Penn Township	28,777[b]	8,900	19,877[b]
Shrewsbury-New Freedom-Railroad	3,519	2,232	1,287
Glen Rock	1,600	1,600	0
Spring Grove	1,669	1,669	0
Red Lion-Dallastown-Yoe	9,995	7,979	2,016
Semi-Urban Area			
Jefferson Borough	540	540	0
Seven Valleys Borough	688	688	0
Loganville Borough	931	931	0
Jacobus Borough	1,360	1,360	0
New Salem Borough	384	384	0
Winterstown Borough	425	203	222
Rural Area			
Main Stem Sub-Basin	3,931	3,931	0
West Branch Sub-Basin	10,934	10,934	0
South Branch Sub-Basin	6,453	6,453	0
East Branch Sub-Basin	4,512	4,512	0
TOTALS	193,399	156,497	36,902

[a] Source of information: 1970 U.S. Census for York County with distribution according to the 1969 York County Sewer Study prepared by the York County Planning Commission.

[b] Includes 5,000 people in urban area outside York County.

The past decade has brought considerable change in development patterns which are reflective of national trends; namely, a declining population within principal central cities (in this case, York), and expanding suburban population around the central cities (e.g. Springettsbury, York, Dover, Manchester Townships). The remainder of the study area is characterized by stable outlying communities with some exceptions such as the Hanover-Penn Township area, which in itself is expanding, and the Red Lion-Dallastown-Yoe Area which is becoming a part of the expanding Greater York Area.

Economic Activity[1]

York County economic activity and that of the study area is virtually dominated by manufacturing and retail-service industry. Manufacturing (accounting for about 47% of the total labor force), in turn, is composed of many types of activities, the most significant being non-electrical machinery and apparel goods. Geographically, most of the manufacutring is located within the Codorus Basin, principally within the Greater York Area.

Retail-service industry is located throughout the study area; however, its importance within the central city (York) has declined because of the retail market growth in suburban areas. Agricultural and mining industry is of minor importance. Two of the three broad industry classifications (manufacturing and retail-service and related) are briefly described in turn.

Manufacturing Industry - Based on 1966 figures, manufacturing employs approximately 47 percent of the total labor force of the area. The largest single category of employees is "machinery except electrical" (with a relatively high average annual wage) followed by apparel (with the lowest average annual wage). Caterpillar Tractor and AMF are among the largest of the non-electrical machinery industries in the area.

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[1] Factual data for this section are taken from several sources: York County Economic Analysis (York County Planning Commission: York; no date given); 3 volumes. York Area Transportation Study: Vol. 2 Analyses and Forecasts (Commonwealth of Pennsylvania; Harrisburg, April 1971).

Major concentrations of manufacturing activity lie within the City of York, north of the City along I-83, in the West York Industrial Park, and in Hanover.

Retail Service and Related Industry[1] - This sector of York County (e.g., retail trade, wholesale trade, service industry) employs approximately 51 percent of the total labor force. While there has been a decline in retail trade in the City of York, this decline has been offset by a relocation in the suburban areas (regional shopping centers being a case in point); however, on an overall basis this group of activities comprises the fastest growing economic sector in the County.

GEOPHYSICAL RESOURCES

Geology, Hydrogeology, Soils

The Codorus Creek drainage basin lies within four physiographic subdivisions of the Piedmont Province as shown in Exhibit I-3. Associated with each of these physiographic units are characteristic rock types which determine the fundamental topographic form, soil development and surface and subsurface drainage. The following descriptive characteristics of each of the physiographic units is extracted from the U.S. Department of Agriculture, Soil Conservation Service report on the Soil Survey of York County, Pennsylvania published in 1963.

The Hanover-York Valley - From Hanover to York, Codorus Creek and the West Branch Codorus Creek flow approximately along the southeast edge of long narrow lowland (2 to 4 miles wide) formed in steeply dipping sedimentary rock of Cambrian and Ordovician Age. The underlying bedrock is largely carbonate (limestone and dolomite) of varying purity. Associated with the carbonates are minor quantities of shales and sandstone. Slopes are nearly level to undulating, except in an area near Nashville where shale hills rise up to 500 feet above the adjacent carbonate lowlands. The carbonates are soluble and weather comparatively rapidly by solutioning. The soils produced by weathering range widely and erratically in thickness and tend to reflect in

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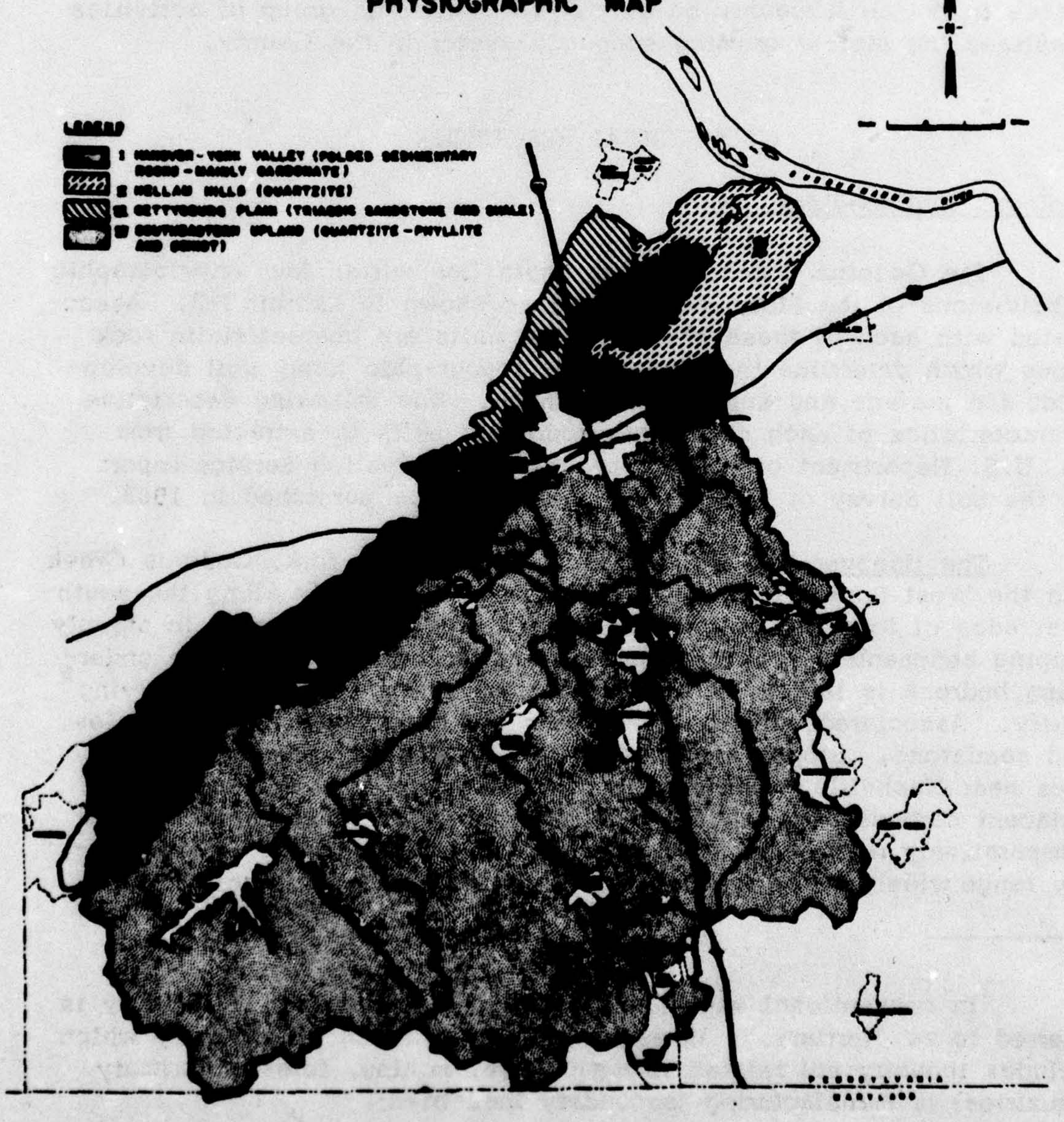
[1] In conventional economic analysis, this category or industry is referred to as "tertiary." In essence, it is a catch-all category which includes industry not related to agriculture, mining, forestry (primary industries) or manufacturing (secondary industries).

Exhibit I-3

CODORUS CREEK DRAINAGE BASIN
PHYSIOGRAPHIC MAP



composition the lithologic characteristics of the present material. The more impure carbonate units give rise to more silty and sandy loam soils while the purer units produce soils higher in clay content. The pressure of sinkholes attest to the presence of well developed internal drainage along solution enlarged joints and crevices. Groundwater underflow is rapid along permeable channels within the rock units but the distribution, orientation, and hydraulic interconnection of the complex channel ways are difficult to determine in a specific manner.

East of York, the sedimentary rock lowland extends as a narrow valley to Wrightsville. At York, however, Codorus Creek turns northward to flow in a narrow, deeply incised valley through the Hellam Hills section south of New Holland.

Hellam Hills - The Hellam Hills physiographic unit is an area of high knolls and elongated ridges formed on bedrock of highly resistant quartzite. Land slopes are long and steep to moderately steep with narrow ridge crests with widths of up to 100 yards. The underlying quartzite bedrock is dense and resistant to weathering and erosion. Associated soils range from silt to sandy loam in texture and from shallow (0 to 20 inches) to deep (greater than 44 inches) in depth. Generally, the thicker soil is associated with the lower land slopes (less than 8 percent) and the steeper slopes (in excess of 15 percent) are more likely to contain thinner, more severely eroded soils.

The Hellam Hills quartzite terrain is restricted to the lower part of the Codorus Creek Basin occurring generally between Glades and Codorus Furnace where Codorus Creek discharges into the Susquehanna River.

Gettysburg Plain - A small area along the northwest flank of the drainage basin, that part generally occurring between Manchester and Emigsville and extending southwest to about Shiloh, lies within the Gettysburg Plain physiographic unit. The Gettysburg Plain forms an extensive physiographic subdivision of the Piedmont Province on the northwest flank of the Codorus Creek Basin. Within this physiographic area the land surface is dissected into low ridges and hillocks forming an undulating to rolling low upland. The surface is formed on relatively soft and easily eroded red shales and sandstones of Triassic age. The soils developed on these materials ranges from shallow to deep and are almost always severely eroded where land slopes exceed about 8 percent. The soils range in composition from sandy loam to clay loam reflecting the sandstone or shales composition of the bedrock. Permeability characteristics also vary according to the rock type, being low to very low in the shale units and low to moderate in the sandstone units

depending on degree of fracturing and relative cleanliness of the sandstone. Generally, the permeability of the Triassic shale and sandstone terrain can be expected to be intermediate between the dense quartzite and other metamorphic rocks and the solution affected carbonate rocks.

Southeastern Upland - The bulk of the land area within the Codorus Creek Drainage Basin, that lying generally southeast of Codorus Creek and the West Branch Codorus Creek from York to Hanover is within the Southeastern Upland physiographic subdivision. The land surface in this physiographic area is characterized by a steep sloped to rolling topography with well defined relatively narrow ridge tops. The bedrock of the area consists of interbedded quartzites and phyllite in a broad band adjacent to Codorus Creek and the West Branch and the Wissahickon schist in the headwaters region of the southern tributaries.

Soils developed on these metamorphized rocks range in texture from silt to sandy loams with a generally good drainability and in thickness from shallow to deep. Over broad expanses of the region, generally deep soils averaging 5 feet or more in thickness and with relatively high permeability, estimated to be in the order of 10 to 100 gallons per day per square foot, are likely to be consistently present.

The bedrock underlying the Upland is generally tight with permeability resulting only from the shallow network of joints and fractures that produce narrow lineal openings in the rock. These are often adequate to provide small water yields to wells, sufficient for domestic and farm needs. Locally, weathering of the Wissahickon schist is reported to extend to depths in excess of 80 to 90 feet. The unconsolidated material is sandy in texture and capable of somewhat larger (limits unknown) water yields.

Hydrology

Basin Description - The West, South and East Branches of Codorus Creek join about three miles southwest of the City of York to form the Main Stem of Codorus Creek. At the confluence, the West Branch drains 93.7 square miles and the South Branch drains 117 square miles; the latter also includes the East Branch which drains 44.9 square miles. Relatively large reservoirs have been constructed on both the West and East Branches. Indian Rock Reservoir and Codorus Creek State Park are on the West Branch; Lakes Williams and Redman of the

York Water Company are on the East Branch. Exhibit I-4 summarizes these elementary basin characteristics.

<u>Climatalogic and Streamflow Records</u> - Five weather stations are maintained within the basin with both preciptation and temperature measured in the York Area at the York Water Company filter plant, and pumping station, at Hanover and precipitation only measured at Glen Rock and Spring Grove. The Glen Rock Station was established in 1951 while the remainder of the stations were established earlier in 1931-1932.

The three long-term streamflow gaging stations existing in the Basin are: at Spring Grove (West Branch; 75.5 sq. mi. drainage area; period of record: since 1929), Near York (South Branch including East Branch; drainage area 117 sq. mi.; period of record: since 1927), and York (Main Stem; drainage area 222 sq. mi.; period of record: since 1940). Their locations are shown in Exhibit I-4.

<u>Rainfall and Runoff</u> - Average annual precipitation over the basin is 41.75 inches. Average annual runoff at the York gage is 221 cubic feet per second (cfs) or 13.52 inches. The average annual runoff for the entire basin is a measure of the total surface water resource, and for the Codorus Creek this amounts to approximately 279 cfs at its mouth. Of this total basin runoff, about 50 cfs is presently used or controlled for municipal and industrial water supply.

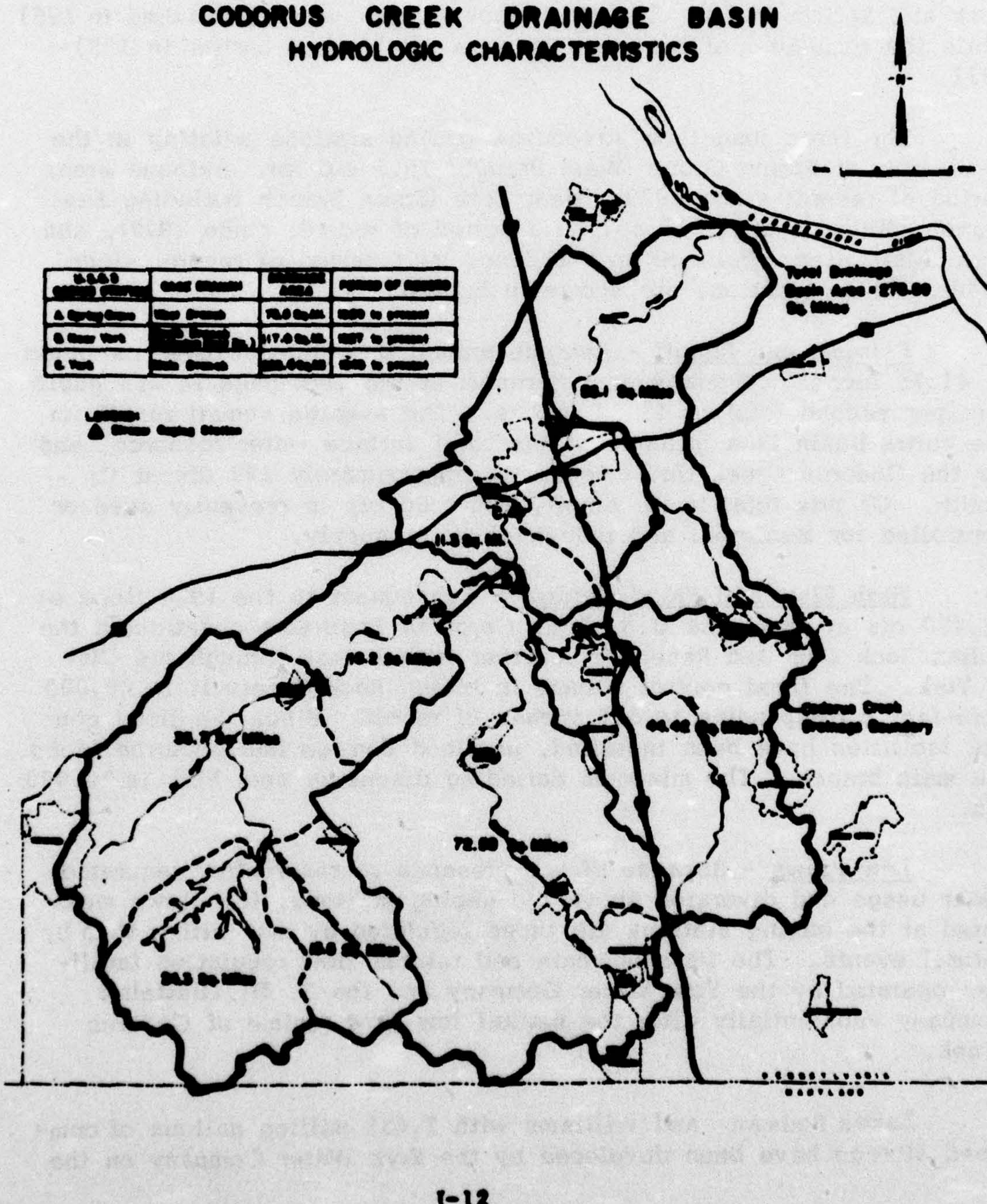
<u>High Flow and Flood Control</u> - Subsequent to the 1933 flood of 32,000 cfs at York, the U.S. Army Corps of Engineers constructed the Indian Rock Dam and Reservoir together with levees through the City of York. The flood control volume in Indian Rock Reservoir is 28,000 acre-feet corresponding to 5.6 inches of runoff. Since the flood control facilities have been installed, no flood damage has occurred along the main branch. The minimum damaging discharge near York is 20,000 cfs.

<u>Low Flows</u> - Because of the presence of reservoirs, regulated water usage and diversion above the gaging stations, low flows measured at the gaging stations are those regulated by man rather than by natural events. The impoundments and related flow regulation facilities operated by the York Water Company and the P. H. Glatfelter Company substantially alter the natural low flow regime of Codorus Creek.

Lakes Redman and Williams with 2,635 million gallons of combined storage have been developed by the York Water Company on the

Exhibit I-4

CODORUS CREEK DRAINAGE BASIN
HYDROLOGIC CHARACTERISTICS



East Branch. When operated in conjunction with the diversion facilities on the South Branch a 33 mgd regulated water supply exists. Presently only 20 mgd of this capacity is utilized. This diverted water is returned to the surface water approximately 5 miles downstream below the City of York.

Water supply facilities operated by the P. H. Glatfelter Company have developed most of the yield potential of the West Branch above Spring Grove. Regulation at three impoundments (Lakes Marburg, Lehman and PaHaGaCo) with a combined storage capacity of 15,800 million gallons permits development of 32 mgd of dependable yield. At present, 17.4 mgd of this capacity is utilized, virtually all for the Glatfelter paper mill, but a small amount also by the City of Spring Grove. These diversions are returned to the West Branch a short distance below the point of diversion.

The Commonwealth of Pennsylvania requires that the York Water Company and P. H. Glatfelter Company maintain minimum flows of 3.8 mgd and 2.4 mgd below their diversion points on the South and West Branches, respectively. Since supply facilities are not presently utilized to their capacity, flows are maintained substantially above these minimum levels. Average flows for each month of the year for the West Branch at Spring Grove, the South Branch just below the York Water Company diversion and the Main Stem of Codorus Creek at York are presented in Exhibit I-5. Exhibit I-6 shows low flows for critical points of these and other areas. These flows are statistical averages for the periods of record indicated. The amounts of the diversions have been increasing over time and are projected to continue increasing in the future. Therefore, a number cannot be presented for the amount of natural flow, diversion flow, or percentage of wastewater flow in the creek unless the point in time is also presented. The particular situation at critical locations in the Basin is discussed in the following paragraphs.

West Branch at Spring Grove - The gaging station is located between the water supply intake for Spring Grove and P. H. Glatfelter Company and the outfall from their wastewater treatment plant (downstream of the intake and upstream of the outfall). Therefore, the actual flow through Spring Grove (and also the available dilution flow) is equal to the published flow minus the diversion. In 1970 this amounted to 6.7 mgd during the critical low flow periods (24.1 mgd, minimum of average monthly flows (1929-1969), minus 17.4 mgd, Spring Grove and Glatfelter water usage). Therefore, below the outfall during the critical low flow period, 28% of the flow in the West Branch was natural flow and 72% was treatment plant effluent. As the Glatfelter water usage increases and as additional regulation to the West Branch

Exhibit I-5

AVERAGE MONTHLY FLOWS

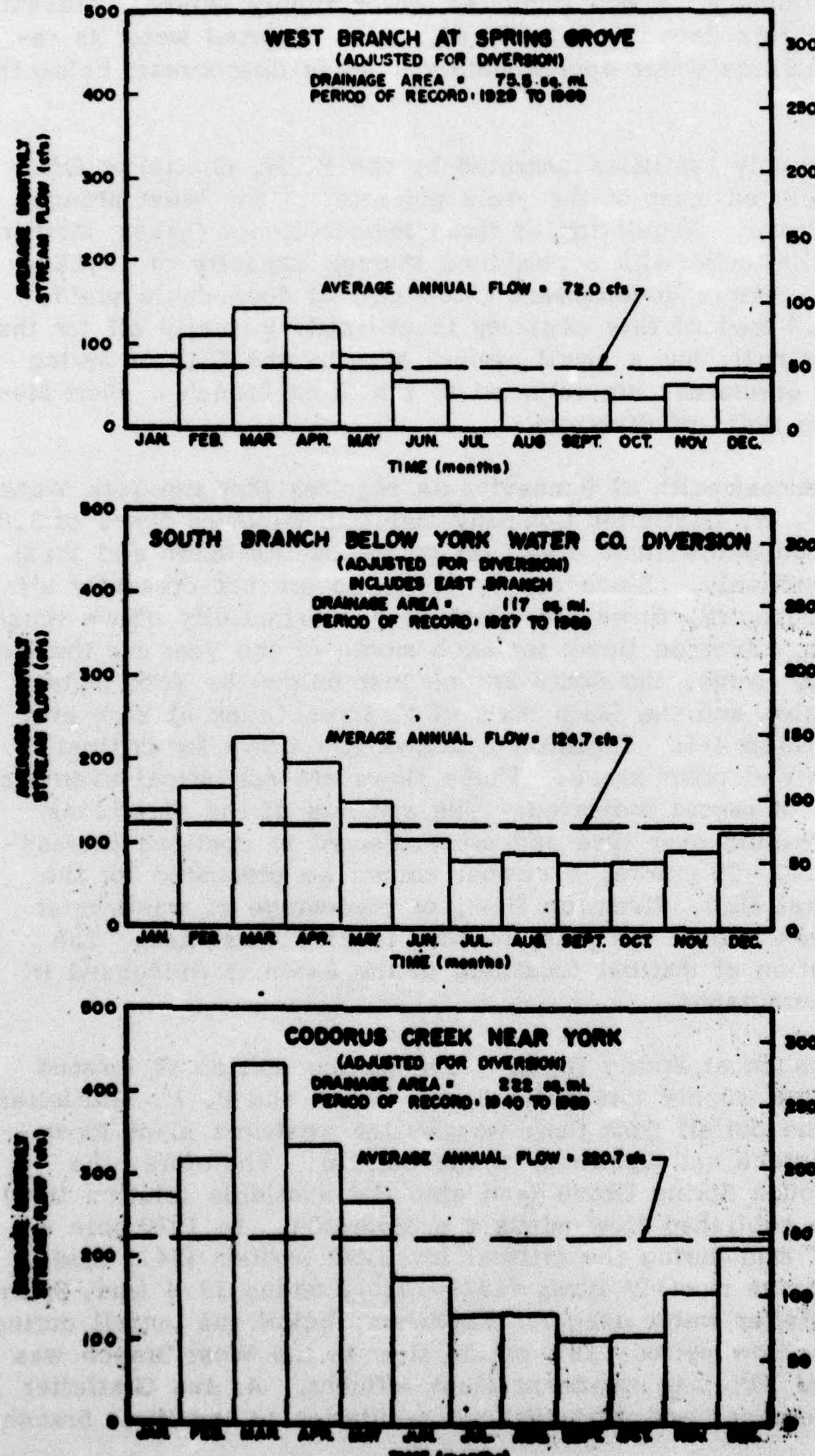


EXHIBIT I-6

LOW FLOWS AT SELECTED POINTS
IN THE CODORUS BASIN

Critical Point	Drainage Area	Min. of Average Monthly Flow for Period of Record Up to 1969 cfs/mgd	Remarks
WEST BRANCH:			
Spring Grove Gage	75.5 sq.mi.	37.4/24.1	Adjusted to include Glatfelter water.
Indian Rock Dam	93.7	46.9/30.2	Includes Glatfelter water.
SOUTH BRANCH:			
Glen Rock	17.2	10.7/6.9	Includes waste discharge.
Gage @York Water Co. Diversion	117	73.1/47.1	Adjusted to include York Water Co. Diversion
MAIN BRANCH:			
Gage @York	222	101.8/65.7	Adjusted to include York Water Co. Diversion.
York STP	256	117.5/75.8	
Mouth	279	128.0/82.6	Includes all waste water flows.
MILL CREEK:			
Mouth	18.9	8.7/5.6	Add waste discharge from Red Lion to Obtain total flow
Oil Creek Mouth	16.8	8.3/5.4	

is effected at Lake Marburg, the total minimum monthly flow will increase due to regulation. However, the natural flow maintained in low flow months will drop and approach the 2.4 mgd required to be maintained by present Commonwealth requirements. This will result in a situation approaching 95% wastewater treatment plant effluent in the West Branch below the outfall during the minimum month. Under this situation, the wastewater treatment plant effluent criteria must approximate stream water standards.

South Branch - The South Branch gaging station is located immediately downstream of the Brillhart diversion facilities of the York Water Company which, in turn, is downstream of the confluence of the East and South Branches. As with the Spring Grove gage, the actual flow at this gage is equal to the published records (which have been adjusted by the U.S.G.S. for the diversion) minus the amount of diversion. In 1970 this amounted to 27.1 mgd during the critical low flow period (47.1 mgd minus 20.0 mgd diversion). This is the quantity of water which together with the West Branch flows through the City of York. If the York water usage increases as projected in other sections of this report and if the total supply is obtained from the South and East Branches by 1980, the actual low period flow at the gage will be reduced to 21 mgd and by 2000 to 7 mgd.

Main Branch at York - This gaging station is at the upstream edge of the City of York and downstream of the confluence of the West and South Branches. It is adjusted by the U.S.G.S. for York Water Company diversions at Brillhart. Estimated actual low flow at this point with 1970 diversions is 45.7 mgd.

Presently, approximately 40 percent (19.4 mgd) of this flow is effluent from wastewater treatment plants at Glatfelter, Spring Grove, Penn Township, and Glen Rock. In the future, a much greater percentage will be effluent as Glatfelter increases its regulation and water usage, as upstream wastewater flows increase and as the York Water Company increases its regulation and diversion.

Main Branch below York - The York Water Company diversions reenter the Main Branch through the York and Springettsbury wastewater treatment plants downstream of the City. Average minimum month flow at the mouth of Codorus Creek is 82.6 mgd. Approximately 50 percent (40 mgd) of this is the effluent from municipal and industrial waste treatment plants in the basin.

PRESENT WATER SUPPLY MANAGEMENT SYSTEMS

A variety of public, industrial, and individual private water supply systems presently serve the Codorus Creek Basin and adjacent study area. Exhibit I-7 shows the major systems serving the urbanized areas. The information presented in this Exhibit represents a compilation of data taken from various sources, including State Health Department water supply inspection reports, water treatment plant operating reports, the 1962 report entitled Water Resources of the Codorus Creek Basin, and private correspondence with water works officials. The present service areas for the major public water supply systems are shown on Exhibit I-8.

The importance of surface waters for water supply is reflected in the fact that utilization of the Basin surface waters for water supply averaged, approximately 37.4 mgd in 1970 while numerous small-scale systems utilized the groundwater resource at a much lesser rate of about 1.0 mgd. In addition, 4.3 mgd of surface waters were being supplied from outside the basin to serve the Hanover-Penn Township Urban Node and the Red Lion-Dallastown-Yoe Urban Node. The principal management facilities for developing these surface supplies are the water impoundments on the West Branch of Codorus Creek (Lake Marburg and Lake Lehman servicing the P. H. Glatfelter Co. and the Borough of Spring Grove, respectively) and the East Branch of Codorus Creek (Lake Williams) which is used in conjunction with direct diversion from the South Branch of Codorus Creek. Glen Rock has an impoundment on Centerville Creek, a tributary to the South Branch, which is utilized only during peak demand periods.

The two major water supply systems in the basin, accounting for some 87% of the total 1970 water usage in the basin and adjoining urban nodes, are the York Water Company public system (20 mgd) and the P. H. Glatfelter Company system (17.2 mgd). It is estimated that in 1970, 88% (173,400) of the population residing in the study area (the basin and the adjoining urban nodes) was serviced by public water systems. The remaining 12% or some 22,800 people, mainly residing in rural areas, utilized individual water supply systems mostly developed from groundwater. The total water usage in the study area exceeds 43 mgd. (Exhibit I-9).

Usage Trends - The per capita daily water usage in the York Water Company service area has steadily increased from 87 gpcd in 1920 to the present figure of 170 gpcd[1]. In 1970 the York Water Com-

[1] York Water Company data.

EXHIBIT I-7

MAJOR WATER SUPPLY SYSTEMS

System Name	Exhibit I-8 Ref. No.	Population Served (1,000's)	Average Pumpage Rate (mgd)	Maximum Pumpage Rate (mgd)	Average Per Capita Daily Consumption (gpcd)	Source of Supply: Wells	Source of Supply: Spring	Source of Supply: Surface	Type of[a] Treatment
Greater York Urban Node									
York Water Co.	1	117.9	20.0	30.0	170		x	x (S. & E. Br. of Codorus Creek)	C, D, F, MnR
Hanover-Penn Township Urban Node									
Hanover Municipal Water Works	2	28.0	3.1	3.8	111		x	x (S. Br. Conewago Creek)	C, D, F
Spring Grove Urban Node									
Spring Grove Boro Water Company	3	2.0	0.2	1.0	100		x	x (Lake Lehman)	C, D, F, FeR
Spring Grove Water Co.	4	P.H. Glatfelter Company	17.2	NA[c]	NA			(W. Br. Codorus Creek)	C
Red Lion-Dallastown-Yoe Urban Node									
Red Lion Municipal Auth.	5	11.4	1.2	2.0	105		x	x (Cabin and Beaver Creeks)	C, D, F, FeR, Fl.

EXHIBIT I-7 (Continued)

System Name	Exhibit I-8 Ref. No.	Population Served (1,000's)	Average Pumpage Rate (mgd)	Maximum Pumpage Rate (mgd)	Average Per Capita Daily Consumption (gpcd)	Source of Supply Wells	Spring	Surface	Type of[a] Treatment
Shrewsbury-New Freedom-Railroad Urban Node									
Shrewsbury Municipal Water Works	6	2.0	0.12	NA	60	x	x		None
New Freedom Municipal Water Works	7	1.4	0.25	NA	178	x			D
Railroad Borough Water Company	8	0.3	0.02[b]	NA	70	x	x		None
Glen Rock Urban Node									
Glen Rock Water Authority	9	1.6	0.13	0.14	82	x	x	x (Centerville Cr.)	C,D,F
Semi-Urban Areas									
Jefferson Borough Water Works	10	0.7	0.02	NA	29	x			None
Loganville Borough	11	0.8	0.07	NA	88	x			None
New Salem Borough	12	1.5	0.06	NA	40	x	x		None
Seven Valleys Municipal Water Works	13	.69	0.06	NA	87	x	x		None
Other Areas									
Heidelberg Township	14	0.14	0.01[b]	NA	70	x			D
Jackson Twp. Water District #1	15	0.23	0.03	0.04	135	x	x		None
West Manchester Township Authority	16	4.8	0.36	NA	75	x			D

EXHIBIT I-7 (Continued)

Totals	Population Served (1000's)	Avg. Pumpage Rate (mgd)	Per Capita Daily Consumption (gpcd)
Public & Private	173.4	25.6	148
P.H. Glatfelter Co.	NA	17.2	NA
TOTAL	173.4	42.8	NA

[a]C - Chemical Treatment
D - Disinfection
F - Filtration
FeR - Iron Removal
MnR - Manganese Removal
Fl - Fluoridation

[b]Estimated since pumpage data was unavailable.

[c]NA - Not available or not applicable.

Exhibit I-8

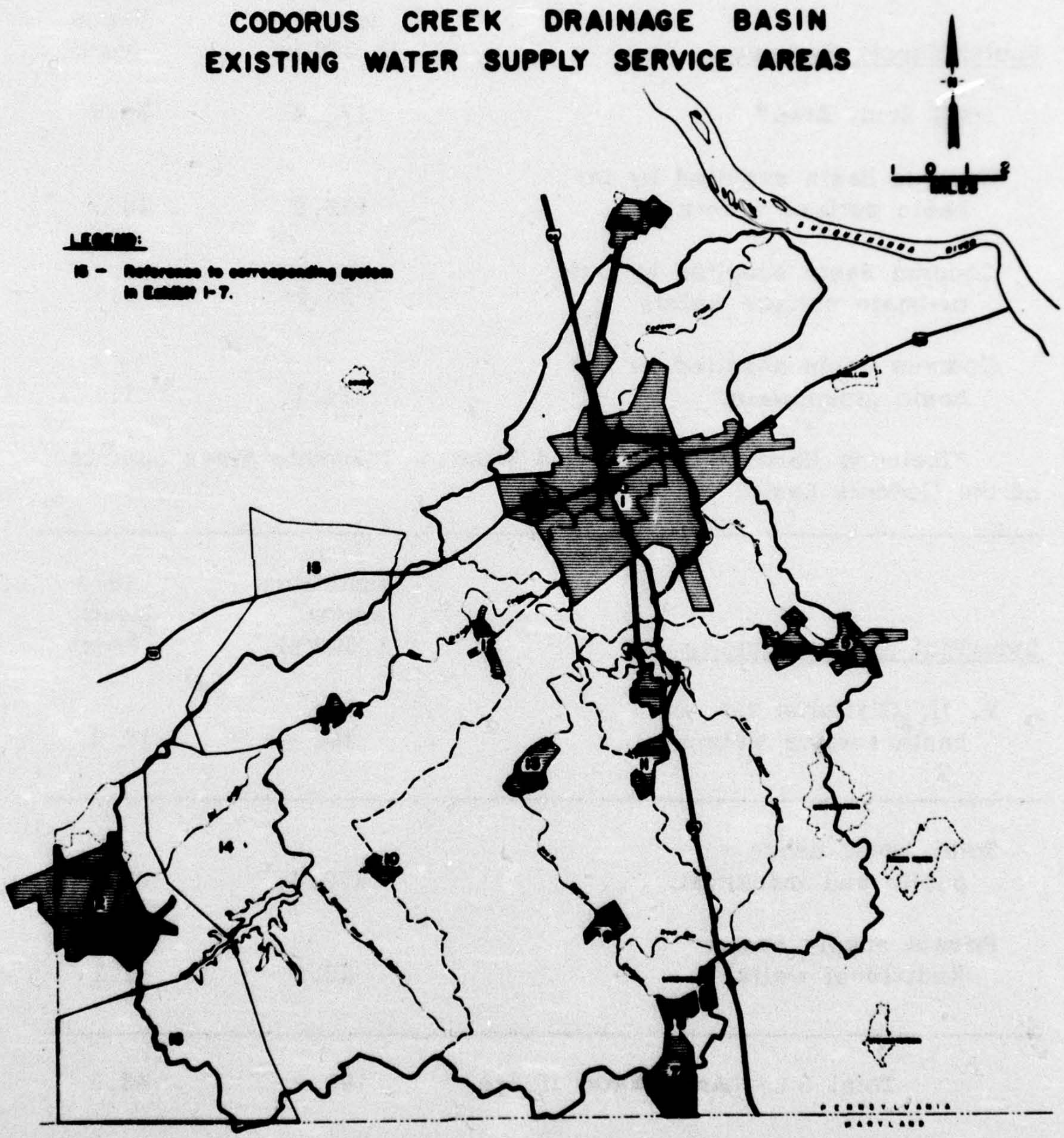

CODORUS CREEK DRAINAGE BASIN
EXISTING WATER SUPPLY SERVICE AREAS
LEGEND:
16 - Reference to corresponding system in Exhibit I-7.
PENNSYLVANIA
MARYLAND

EXHIBIT I-9

SUMMARY OF WATER USAGE CONDITIONS

Public Supply Systems	Population Served (1,000's)	1970 Usage (mgd)
Total Study Area*	173.4	25.6
Codorus Basin supplied by in-basin surface waters	119.9	20.2
Codorus Basin supplied by out-of-basin surface waters	16.9	1.7
Codorus Basin supplied by in-basin groundwater	14.1	1.1

*Includes Hanover Borough and Windsor Township Areas outside of the Codorus Basin.

Industrial Supply Systems	Population Served (1,000's)	1970 Usage (mgd)
P. H. Glatfelter Co. in-basin surface waters	NA	17.2
Total water usage - public and industrial	173.4	42.8
Private supply system (individual wells)	22.8	1.1
Total Study Area Water Usage	196.2	43.9

pany supplied approximately one-half of its total flow (9.8 mgd) to the industrial-commercial sector. Since the other urban areas are less industrialized, their per capita consumption figures are much less.

Surface Water Development

Exhibit I-9 shows the importance of Codorus Creek surface waters in the satisfaction of the study area's water supply needs. Extensive storage and diversion programs exist which have developed a major part of the total surface water supply capability of the Basin. These include the two storage lakes and diversion works of the York Water Company which regulate the South and East Branches of the Creek and the three storage impoundments on the West Branch which regulate the flows for the supply needs of the P. H. Glatfelter Company.

The total available dependable supply capability of these two flow management systems is presently 59.2 mgd based on the following breakdown:

	Dependable Yield (mgd)		
	Gross Yield	Min. Required Flow Release	Net Yields
York Water Company impoundments (Lakes Williams, Redman and South Branch diversion)	33.0	3.8	29.2
West Branch impoundments (Lakes Marburg, Lehman, PaHaGaCo)	32.4	2.4	30.0

This compares to a present (1970) usage of 37.2 mgd (20.0 mgd by the York Water Company and 17.2 mgd by Glatfelter).

PRESENT WASTEWATER MANAGEMENT SYSTEMS

Total wastewater discharges to the Codorus Basin excluding septic systems average approximately 40 mgd. Dominating this total are the 17.2 mgd average discharges from the York area municipal treatment plants (City of York and Springettsbury Township) which serve 81,000 persons plus numerous industries in York and its suburbs, and

the 17.2 mgd average discharge from the P. H. Glatfelter Company. These sources together account for 86 percent of the 40 mgd basin total. Other municipal discharges total about 2.0 mgd, and other private industrial discharges total 2.7 mgd. Septic system discharges in publicly unserved areas are relied upon by about 80,000 persons with an estimated discharge of about 8 mgd. In addition to the discharges within the Codorus Basin, itself, there are discharges totalling 2.2 mgd to adjacent basins from the Dover treatment plant and the Hanover treatment plant.

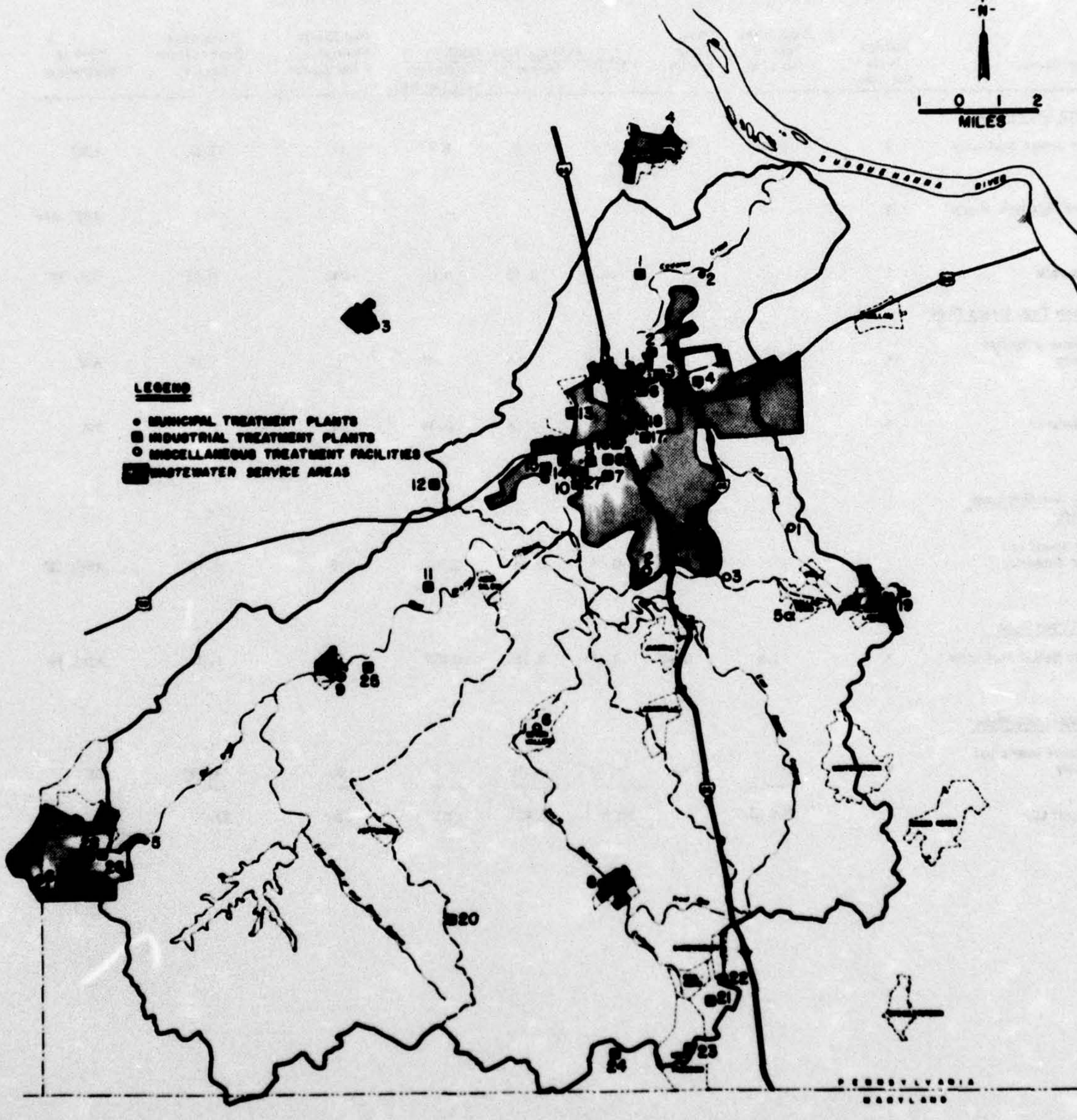
Municipal Wastewater Systems

The existing municipal systems and their service areas are presented in Exhibit I-10 with pertinent information provided in Exhibit I-11. The information presented in Exhibit I-11 represents a compilation of data from several sources; namely: State Health Department waste inspection reports, sewage treatment plant operating reports, the 1968 York County sewage study, the 1970 City of York report on combined and separate sewer discharges, and private correspondence with treatment plant officials.

Because of a paucity of data for determining a breakdown of the flow sources, a procedure was developed for estimating the domestic, commercial-industrial, and infiltration flow components whereby domestic flow estimates are based on domestic water consumption, infiltration estimates are based on typical design proportion, and industrial-commercial flow is assumed to be the remaining flow. York Water Company data indicate a 1970 average per capita domestic consumption figure of 87 gpcd for the 118,000 people serviced. Based on the assumptions: (1) that domestic water consumption is equal to domestic wastewater generation, and (2) that sewered areas generally tend to consume more water than unsewered areas, it was estimated that the domestic per capita wastewater generation for the York treatment plant was 100 gpcd which for 81,000 persons is approximately 8.1 mgd. However, this does not take into account the effects of infiltration into the sewer system. For areas such as York where the groundwater elevations are generally not a problem, the infiltration would account for no more than 10-15% of the average sewered flow. For the 1970 flow of 17.2 mgd, this would result in approximately 1.8 mgd due to infiltration from all components or 0.9 mgd from the domestic component, alone. Therefore, the domestic wastewater flow (including infiltration) into the York STP for 1970 is estimated to be 9.0 mgd with a resulting industrial-commercial flow (including infiltration) of 8.2 mgd.

Exhibit I-10

CODORUS CREEK DRAINAGE BASIN WASTEWATER DISCHARGE LOCATIONS



EXISTING MUNICIPAL DIRECT WASTEWATER DISCHARGES

System Name	Exhibit I-10 Ref. No.	Population Served (1000's)	Peak Flow (MGD)	Average Flow (MGD)			Per Capita Domestic Flow (gpcd)	Treatment Design Flow (MGD)	Type of Treatment
				Total	Domestic	Industry-Commercial			
Greater York Urban Node									
York City Sewer Authority	1	81.0	23	17.2	9.0	8.2	111	18.0	ASC
Borough of Springettsbury	2							8.0	ASC, AFP
Dover Borough	3	1.2	NA	0.15	0.12	0.03	100	0.25	TF, SF
Hanover-Penn Twp. Urban Node									
Penn Township Sewage Authority	5	6.3	1.4	1.0	.55	.45	86	1.75	ASC
City of Hanover	6	16.6	NA	2.0	1.66	0.34	100	2.5	TF
Dallastown-Yoe-Red Lion Urban Node									
Red Lion Municipal Sewage Authority	7	5.7	0.49	0.26	0.25	0.01	46	0.70	ASC, SD
Glen Rock Urban Node									
Glen Rock Sewer Authority	8	1.6	0.46	0.153	0.152	0.001	95	0.30	ASC, FF
Spring Grove Urban Node									
Spring Grove Municipal Authority	9	1.7	NA	0.10	0.10	-	60	0.345	TF
TOTAL		114.00		20.9	11.83	9.03	104	31.7	

Exhibit I- 11

Sewer Type[1]	Receiving Waterway	Municipal Waste Loadings (mg/l: lbs/day) BOD$_5$	Suspended Solids	Total Nitrogen as N	Phosphorus as P	Heavy Metals	Remarks
C, S	Main Stem Codorus Creek	50 : 7,170	90 : 12,910	14 : 2,010	8 : 1,150	2.6 : 375	Increase capacity to 26 MGD. Provision in second stage for Phosphorus Removal.
C	Main Stem Codorus Creek						Anticipate initial flows of 4 MGD in the near future.
S	Fox Run (Little Conewago Ck.)	15 : 20[2]	10 : 15[2]	20 : 25[2]	8 : 10[2]		
S	Oil Creek (W. Br. Codorus Ck.)	39 : 325	39 : 325	0.3 : 5	4 : 35		
S	Plum Creek (S. Br. Conewago)	30 : 500[2]	35 : 585[2]	20 : 330[2]	8 : 135[2]		
S	Mill Creek (Codorus Ck.)	8 : 20	9 : 20	40 : 90[2]	16 : 35[2]		Low Flows since Sewage Rate =1.75 x water rate.
S	S. Br. Codorus Ck.	16 : 40	18 : 45	20 : 50[2]	8 : 20[2]		
C	W. Br. Codorus Ck.	62 : 50	120 : 100	20 : 20[2]	8 : 5[2]		
		8,125	14,000	2,530	1,390	375	

[1] APP - Aerated Polishing Pond
ASC - Activated Sludge:Contact Stabilization
PP - Polishing Pond
SD - Sludge Dewatering
SF - Sand Filter
TF - Trickling Filter

[2] NA - not available

[3] Estimated Waste Loadings

The total municipal wastewater flow for the Codorus Creek Basin and the adjoining urbanized nodes approximates 21 mgd of which 42% (9 mgd) is generated by sewered industries. Within the York Urban Node, the Borough of Springettsbury has a treatment plant being put into operation with projections for treating a 4 mgd flow in the near future. This will reduce sewage flows in the York treatment plant by 3.4 mgd with the remaining 0.6 mgd being contributed by newly sewered areas served by the Springettsbury plant. It is anticipated this will relieve the overburdened condition presently being experienced by the York STP as exemplified by its high BOD and suspended solids effluent concentrations as shown in Exhibit I-11.

The Dover urbanized area presently discharges to an upstream tributary of the Conewago Creek. Dover Brough is completely sewered, therefore, it is assumed the entire 1970 population (1,168) in the borough generates a domestic per capita wastewater flow of 100 gpcd or 0.12 mgd. Because there is no industry, the remaining 0.03 mgd is generated by the commercial sector.

A sewage treatment plant has been designed to service 4,000 homes located in Dover and Manchester Townships. Present plans envision a 1990 design flow of 1.75 mgd which will be treated by the contact stabilization biological treatment process.

A sewage treatment plant has also been designed for the Shrewsbury-New Freedom-Railroad Urban Nodes with construction anticipated to begin in the near future. It is designed to initially treat 0.91 mgd of wastewater with ultimate capability for handling 1.35 mgd utilizing the contact stabilization treatment process.

Information on the municipal wastewater sources for the City of Hanover were not ascertained; therefore, the domestic sector contribution, as shown in Exhibit I-11, was estimated on the general design basis of 100 gpcd.

<u>Manufacturing-Commercial Systems</u>

In addition to the industrial flows discussed in the previous section, twenty-five industries within the Codorus Creek Basin discharge treated wastes directly to the waterways as shown on Exhibit I-10. Twenty-four of these industries discharge a combined total of 2.7 mgd directly to the Creek. The one remaining industry the P. H. Glatfelter Company is discussed separately. The extent of treatment before discharge and the characteristics of the wastewaters vary con-

siderably. Exhibit I-12 summarizes available information for each of the industries.

The greatest single source of industrial wastewater in the basin is the P. H. Glatfelter Company, manufacturer of 450 tons per day of bleached pulp and 575 tons per day of fine quality printing paper. Its average wastewater flow of 17.2 mgd is a large proportion of the 46.5 mgd average flow of the West Branch of Codorus Creek. The paper mill waste, despite unusually effective treatment facilities, is characterized by high COD and color.

The only other direct industrial discharge into the West Branch is a single plant in Hanover Borough. The South Branch of Codorus Creek has three direct industrial discharges with a combined total flow of 40,000 gallons daily. The significance of these waste sources is not their size but their locations upstream in the Basin. The East Branch of Codorus Creek has no direct industrial discharges.

The largest concentration of direct industrial discharges into the basin is in the Greater York Urban Node draining into the main stem of Codorus Creek. Seventeen plants employing about 8,900 people discharge an average of about 2.5 mgd of process and cooling water. Twelve of these plants employing about 8,300 people are in a metal finishing or related industry. The combined average flow from metal finishing plants of 2.0 mgd is very low in nutrients but potentially high in heavy metals. Several of these plants are under order from the Commonwealth of Pennsylvania to reduce the metals content of their wastewater. Besides the metal finishing industries, the only major direct discharges are from three plants manufacturing mineral products. Their average wastewater discharges total more than 0.5 mgd.

Private Systems

Analyses of the municipal treatment works within the study area indicates that 59% (113,000) of the population are presently serviced by public facilities generating a total flow of approximately 20.7 mgd. Thus, the remaining 41% (80,000) of the 193,000 people residing in the study area utilize private disposal systems, namely septic tanks.

Miscellaneous Systems

There are five school facilities and one trailer court in the basin which have their own treatment plants. They are included in Exhibit I-10,

EXISTING INDUSTRIAL WASTEWATER TREATMENT FACILITIES

Industry Name	Exhibit I-10 Reference No.	Type of Industry	No. of Employees	Flow (MGD)	Type of Treatment	Remarks
GREATER YORK URBAN NODE						
<u>Manchester Township</u>						
General Time Corp.	1	Metal Finishing	80	.01-.015 (P)	CP	Under observation or compliance by the Commonwealth of Pennsylvania
<u>Springettsbury Township</u>						
American Machine and Foundry	2	Metal Finishing	1,000	.24 (P) .7 (C)	CP	Parking lot drainage also has significant Cr^{+6}, PO_4, CN. Under observation or compliance by the Commonwealth of Pennsylvania
Cole Steel Equip. Company	3	Metal Finishing	400	.014-.06 (P)	CP	Under observation or compliance by the Commonwealth of Pennsylvania
York-Shipley, Inc.	4	Metal Finishing	400	.019 (P)	UND.	Suspected source of low concentration Heavy Metals. Not included in State records.
<u>Spring Garden Township</u>						
Borg-Warner, York Div.	5	Metal Finishing	3,194	.15 (P) .30 (C)	CP	Under observation or compliance by the Commonwealth of Pennsylvania
Certain-Teed Products Co.	27	Roofing Products	200	.15-.4 (C)	None	Process water to York STP
Cole Steel Equip. Company	6	Metal Finishing	700	.03-.04 (P)	CP	Under observation or compliance by the Commonwealth of Pennsylvania
The McKay Company	7	Metal Finishing	540	.036 (C)	None	Process water to York S.T.P. Analysis is for tributary of Codorus Creek draining plant property
Ness Company	8	Washing Equipment		.0015 (P)	S	Suspected source of BOD. Not included in State records.
New York Wire Company	9	Metal Finishing	37	.030-.024 (P)	CP, TP	Under observation or compliance by the Commonwealth of Pennsylvania
York Water Company	10	Water Filtration Plant				

Exhibit I-12

Receiving Waterway	Industrial Waste Loadings (mg/l: lbs/day) BOD$_5$	Suspended Solids	Total Nitrogen as N	Phosphorus as P	Special Characteristics
Main Stem Codorus Creek		16-50:6.3		.24 : .03	Fe=1.7-3.7, Zn=0-.46, Cu=0-0.5 T.H.M. = 4.7: .6
Main Stem Codorus Creek		20:40		1.71 : 3.4	Cu=0-0.5, Cr^{+3}=.5-.7, Zn=.14-.16, Fe=0.8 T.H.M. = 2.1: 4.2
Little Codorus Creek		30: 15	NH_3= .28: .14	2.1-7.7: 4.0	Cu=0-1, Cr^{+3}=0-4, Cr^{+6}=.15, Ni=1.8, Zn=0-2, Fe=0-1.1 T.H.M. = 11.3: 5.7
Little Codorus Creek					
Main Stem Codorus Creek		20-80:100	NH_3=0.8 : 1.0	0-1.6: 2.0	Cu=0-.04, Cr^{+3}=.16-.52 Ni=0-.38, Zn=0.7-2.0, Fe=0.8, F=0.8-1.2 T.H.M. = 3.7:4.6
Main Stem Codorus Creek					
Main Stem Codorus Ck. via Poorhouse Run		30-50:16.7	NH_3=0.28 : .09	0	Cu=0-0.3, Cr^{+3}=0-0.2, Zn=3-10.8, Fe=4.4-6.4, F=0.7-1.7, CN=.36-1.5 T.H.M. = 20.9:7.0
Main Stem Codorus Creek		0-120:40	NH_3=.32 : .10	.05-.09	Cu=0-.04, Zn=.03-.22 Fe=0-3.4, F=.1-.2 T.H.M. = 3.9:1.2
Main Stem Codorus Creek					
Main Stem Codorus Creek		10: 2		.09-.6: .12	Cu=.12-.2, Cr^{+3}=0-.05, Ni=0-.11, Zn=0.4-1.2, Fe=2.9-7.0 T.H.M. = 8.6:1.7

EXISTING INDUSTRIAL WASTEWATER TREATMENT FACILITIES

Industry Name	Exhibit I-10 Reference No.	Type of Industry	No. of Employees	Flow (MGD)	Type of Treatment	Remarks
West Manchester Township						
Bowen-McLaughlin	11	Ordnance	700	.005-.04 (P)	CP	
Dolomite Brick Corp.	12	Mineral Products		.002 (P)	STP	
York Stone and Supply	13	Mining	104	(3.5)	S	Quarry drainage discharged to limestone through which it drains. Not considered a direct discharge.
West York Borough						
Medusa Cement	14	Mineral Products	212	.8 (P) .1 (C)	S	Recycled internally- Not considered to be a contaminating effluent.
The Pfaltzgraff Company	15	Mineral Products	191	.025 (P)	CP	Process water contains fine clay particles.
York City						
American Chain & Cable Company	16	Metal Finishing	310	.15 (P)	S	Under observation or compliance by the Commonwealth of Pennsylvania
ACCO-S. W. Plant	17	Metal Finishing	850	.18 (P) .20 (C)	CP	
New York Wire Company	18	Metal Finishing	185	.04-07 (P)	CP	Under observation or compliance by the Commonwealth of Pennsylvania
RED LION URBAN NODE						
Red Lion Borough						
Flinchbaugh Pr., Inc.	19	Metal Finishing	400	.035 (C)* .063 (P)	CP, F	Not in Codorus basin, but may be included in treatment plan.
Radco		Metal Finishing	65	.01	CP	*Does not include 0.06 MGD domestic plant flow discharged to sewer system
GLEN ROCK URBAN NODE						
Codorus Township						
Aircraft Marine Pr.	20	Metal Finishing	125	.03 (P)	CP	

Exhibit I-12
(Continued)

Receiving Waterway	Industrial Waste Loadings (mg/l: lbs/day)				
	BOD_5	Suspended Solids	Total Nitrogen as N	Phosphorus as P	Special Characteristics
W. Branch Codorus Creek					Cu=.1, Cr^{+3}=.5, Cr^{+6}=.05, Zn=.1, Fe=.3 T.H.M. = 1.1:.37
W. Branch Codorus Creek					
Not Direct Discharge					
Main Stem Codorus Creek					
Main Stem Codorus Creek					
Main Stem Codorus Creek		30-80:100	NH_3=0.4:.5	0-.3:.38	Cu=.23-.34, Cr^{+3}=.06, Ni=.92, Zn=5.85-25, Fe=4.5-13, Co=.19, CN=0-.1 T.H.M. = 39.6:50
Main Stem Codorus Cr. via Poorhouse Run		60:90			
Main Stem Codorus Cr. via Poorhouse Run		20-120:70	NH_3=.24:.14	.05-.09:.03	Cu=0-2, Cr^{+3}=0-.06, Ni=.1, Zn=.2-81, Fe=.1-1 T.H.M. = 84.2:50.4
Little Fishing Creek					Cr^{+3}=.07, Ni=.11, Zn=.95-1.59 T.H.M. = 1.8:.9
Little Fishing Creek					
S. Branch Codorus Creek via Krebs Run		20-80:20	NH_3=0.7:.2	0.05:.01	Cu=.27-1.1, Cr^{+3}=.05, Ni=0-.11, Zn=.08-1.21, Fe=0-.3 T.H.M. = 2.8:.7

EXISTING INDUSTRIAL WASTEWATER TREATMENT FACILITIES

Industry Name	Exhibit I-10 Reference No.	Type of Industry	No. of Employees	Flow (MGD)	Type of Treatment	Remarks
SHREWSBURY-NEW FREEDOM RAILROAD URBAN NODE						
<u>Shrewsbury Borough</u>						
Hungerford Packing	21	Food Products	25-150	.02 (C)	None	Process wastewater is disposed on land by spray irrigation.
Superior Wire	22	Metal Finishing	40	.0015 (P)	None	Propose neutralization of alkaline rinse waters and discharge to cesspool.
<u>New Freedom Borough</u>						
Boyds Laundromat	23	Laundry		.007 (P)	CP	Under observation or compliance by the Commonwealth of Pennsylvania
Charles G. Summers, Inc.	24	Food Products	125-430	.04 (C)	None	Process wastewater is disposed on land by spray irrigation at the rate of 0.18 MCD
SPRING GROVE URBAN NODE						
<u>Spring Grove Borough</u>						
P. H. Glatfelter	25	Paper and Pulp	1,100	17.2 (P)	ASC	
HANOVER PENN TWP. URBAN NODE						
<u>Hanover Borough</u>						
Hanover Wire Cloth Div.	28	Metal Finishing	233	.04-.10(P)	CP	Discharge to Hanover STP in May-June, 1971
Keystone-Seneca Wire Cloth	26	Metal Finishing	162	.012-.019 (P)	S	Under observation or compliance by the Commonwealth of Pennsylvania
TOTALS IN BASIN (lbs/day)			11,390+	18.9		

NOTES:

(P) Process water
(C) Cooling water
UND. Undetermined
CP Chemical precipitation
S Sedimentation
STP Sewage Treatment Plant
TF Trickling Filter
F Filtration
ASC Activated Sludge, Contact Stabilization
T.H.M. Total Heavy Metals
Totals Based on Available Data.

Exhibit I-12
(Continued)

Receiving Waterway	Industrial Waste Loadings (mg/l: lbs/day) BOD_5	Suspended Solids	Total Nitrogen as N	Phosphorus as P	Special Characteristics
S. Branch Codorus Creek					
S. Branch Codorus Creek					Zn } Present Al }
S. Branch Codorus Creek	80: 4.7	130:7.6		53: 3.1	Fe=1.0 Alkyl benzene sulfonates=28
S. Branch Codorus Creek					
W. Branch Codorus Creek	12: 1710	50: 7200	NH_3 =3.5: 500 Org =2.5 :360 NO_3 =7 : 1000	0.2: 30	Color = 800-1000 units COD =225: 32,275 Dis. Solids = 1575 : 225,930
W. Branch Codorus Creek via Oil Creek		20 - 50: 42	NH_3 = 0.4: .03	0.14 - 0.28: 0.2	Cu = .12, Zn = 1.5-4, Cr = .07-.34 Fe = .8-3.2, Ni = 0-.11 F = 6.6-35, T.H.M. = 7.8:6.5
W. Branch Codorus Creek via Oil Creek		8-237: 38		0	Cu=0-.12, Zn=0-42, Fe=0-15, SO_4=2460, Chlorides=11-51 T.H.M. = 57: 9.0
	1,505	6,796	1,627	30.1	T.H.M. = 136.4

and their operations are summarized in Exhibit I-13. The combined flow for all six is approximately .04 mgd.

Irrigation with Wastewater

There are presently two canning companies in the Basin which irrigate their wastewater on land; the Hungerford Packing Company and Charles G. Summers, Inc. The Commonwealth of Pennsylvania has no record of ground or surface water quality impairment which could be attributed to these operations.

Waste Loadings

Exhibit I-14 summarizes the waste loadings from municipal and industrial sources for each of the Codorus Creek sub-basins. These loadings are based on the available data as presented in Exhibits I-11 and I-12. Due to the lack of data, typical concentrations for municipal wastewater parameters were estimated for a number of the systems presented in Exhibit I-11. Because of the extremely low per capita flow for the Red Lion system, the nutrient concentrations were estimated at double that normally found in municipal sewage. Nutrient concentrations of the Penn Township effluent were rather small since 30% of the plant flow was comprised of nutrient-deficient cannery wastes. It is evident from Exhibit I-14 that the waste loadings of the P. H. Glatfelter Company and of the domestic and industrial development in the York area are the major point sources.

Stormwater and Combined Sewer Effects

The pollutional load contributed by stormwater and combined sewer discharges to a receiving watercourse often appears insignificant in contrast with the average loadings contributed by a STP effluent. However, the impact of these discharges is greater than the average loadings would indicate since storm flows occur as shock loadings to the watercourse which can inflict great damage to the aquatic environment because of both oxygen depletion and transitory nutrient enrichment.

Portions of Springettsbury Township and the City of York have combined sewer systems. All of Spring Grove Borough is served by

EXHIBIT I-13
MISCELLANEOUS TREATMENT FACILITIES

Owner	Exhibit I-10 Ref. No.	No. People Served	Flow (GPD)	Design Flow (GPD)	Type of Treatment	Receiving Waterways	Remarks
Main Stem Drainage Basin							
Dallastown Sch. Dist. Ore Valley Elem. Sch. York Township	1	400	3,400	8,000	Aeration, Cont. Stab., & Sand Filter	Little Codorus Creek	95-98% BOD removal (Design)
Dallastown Sch. Dist. Leaders Heights Elem.Sch. York Township	2	470	3,400	8,000	Aeration, Cont. Stab., & Sand Filter	Main Stem Codorus Creek	95-98% BOD removal (Design)
M&G Trailer Ct. York Township	3	200	NA	12,300	NA	Little Codorus Creek	NA
Red Lion Sch. Dist. Locust Grove Sch. Red Lion Borough	4	NA	NA	NA	NA	NA	NA
East Branch Drainage Basin							
Dallastown Sch. Dist. Jr.-Sr. High Sch. York Township	5	2,400	16,000	54,000	Aeration, Cont. Stab., & Sand Filter	E. Branch Codorus Creek	95-98% BOD removal (Design)
South Branch Drainage Basin							
Spring Grove Sch. Dist. Seven Valleys Elem. Center Seven Valleys Borough	6	247	2,000	6,300	Aeration, Sand Filter	S. Branch Codorus Creek	92% BOD removal (Design)
TOTAL			24,800				

Note: Based on typical effluent concentrations for these type of treatment facilities the total miscellaneous treatment waste loadings were estimated as follows:

BOD_5 = 3 lbs/day
Suspended Solids = 2 lbs/day

Total Nitrogen as N = 4
Total Phosphorous as P = 2
NA = Information not available

EXHIBIT I-14

PRESENT MUNICIPAL-INDUSTRIAL WASTE LOADINGS

Sub-basin	Waste Loadings (#/day)						
	COD	BOD_5	Solids Total	Solids Suspended	Phosphorus	Nitrogen	Total Heavy Metals
West Branch Codorus							
Municipal	-	375	-	425	40	25	-
Industrial	32,275	1,710	225,930	7,240	30	1,860	9
South Branch Codorus							
Municipal	-	40	-	45	20	50	-
Industrial	-	5	-	28	3	-	1
East Branch Codorus							
Municipal	-	-	-	-	-	-	-
Industrial	-	-	-	-	-	-	-
Main Stem Codorus							
Municipal	-	7,170	-	12,910	1,150	2,010	375
Industrial	-	-	-	480	10	2	75
TOTAL	32,275	9,300	225,930	21,128	1,253	3,947	460

Note: - (indicates not determined).

combined systems. All of the other communities are served by separate storm systems to the extent that they have been developed.

The Commonwealth of Pennsylvania has issued orders to the City of York to conduct a study of the pollutional effects of the combined discharge. The City of York has submitted a plan that would accomplish a separation of the limited portion of their collection system that is combined. A summary of selected loadings contributed by the existing York storm and combined systems is given below:

Comparison of Total Creek Loadings[1]
Combined Discharge Study - York, Pennsylvania
in lbs./yr.

	BOD	Sus. Solids	PO_4-P
Stormwater runoff (3,300 acres)	122,000	600,000	7,600
Combined Sewer discharge(147 acres)	9,223	63,846	
Present Annual Average Treatment Plant Effluent	2,000,000	5,000,000	223,000
Penn. New Effluent Standards	550,000	550,000	64,600

[1] Report and Study on the Location and Quantity of Combined Discharges, City of York, August, 1970 by Albright and Friel, Inc., Philadelphia, Penn.

The data presented above reveals that the gross contribution of suspended solids to Codorus Creek on an annual basis from stormwater systems is equal to that permitted by present State standards for the York wastewater treatment plant effluent. Total BOD loading from storm flow is 20 percent of the allowable wastewater effluent loading whereas phosphate is shown as 10 percent of that which will remain in the wastewater after achieving 80 percent removal. Similar relationships will likely exist for other urban areas in the basin. The total effect of the small combined sewer area is shown to be minor compared to that of the separate stormwater system discharges.

The impact of stormwater pollution on a watercourse is a function largely of the amount of stormwater compared to the natural and storm flow of the watercourse and the disposition of the pollution material added. In the Codorus Creek Basin most of the urbanized area served by storm sewers is in the lower Main Stem area where natural stream flows are substantial particularly during and after storms. Time of travel to the Susquehanna is short and velocities are high. These

conditions cause rapid movement of storm pollutants to the Susquehanna with minimal in-basin sedimentation or potential D.O. sag. The major local effects would occur where storm sewers discharge into the local small streams that drain the urban area. In these situations, contaminated urban storm runoff can comprise the major part of total flow and periodically produce severely degraded conditions in the stream.

The effects of urban storm runoff from the upper basin communities on the in-basin waters may be more severe than that of the York Area due to the limited natural flows and the potential for settling out downstream. D.O. sag, settling of suspended solids and retention of nutrient loadings are all significant concerns.

Management of Sludge Solids

The management of accumulated solids is a major environmental problem in any urbanized area where conventional physical and biological treatment processes are employed. In the Codorus Creek Basin, solids management is even more acute due to the generation of the paper mill sludge which is approximately equivalent in quantity to all of the municipally generated sludge (in wet-tons per year).

Municipal Sludge Disposal - Present practices of municipal sewage sludge management in the basin center around the application of treated solids (anaerobically and aerobically digested) to the land as agricultural fertilizer and for soil conditioning. Virtually all municipal treatment plant solids generated in the basin, estimated at 60,000 wet-tons per year, are disposed of in this manner as reported in Exhibit I-15.

Properly managed, land application of solids is economically and environmentally the most satisfactory method of disposal because it accomplishes resources recovery by recycling nutrients and organic materials to their agricultural origin.

Unfortunately, the present application program in the Codorus Basin appears to be supervised in only a very rudimentary manner. Sludge is hauled to agricultural areas as orders are received from the farmer. It is then applied to the land by the haulage truck in a manner determined by the farmer. The present cost of the sludge disposal operation for the City of York is estimated at $2.00 per wet-ton (sludge with 15% solids) including trucking and land application. During winter months the sludge is hauled to a temporary storage location for later disposal on land.

EXHIBIT I-15

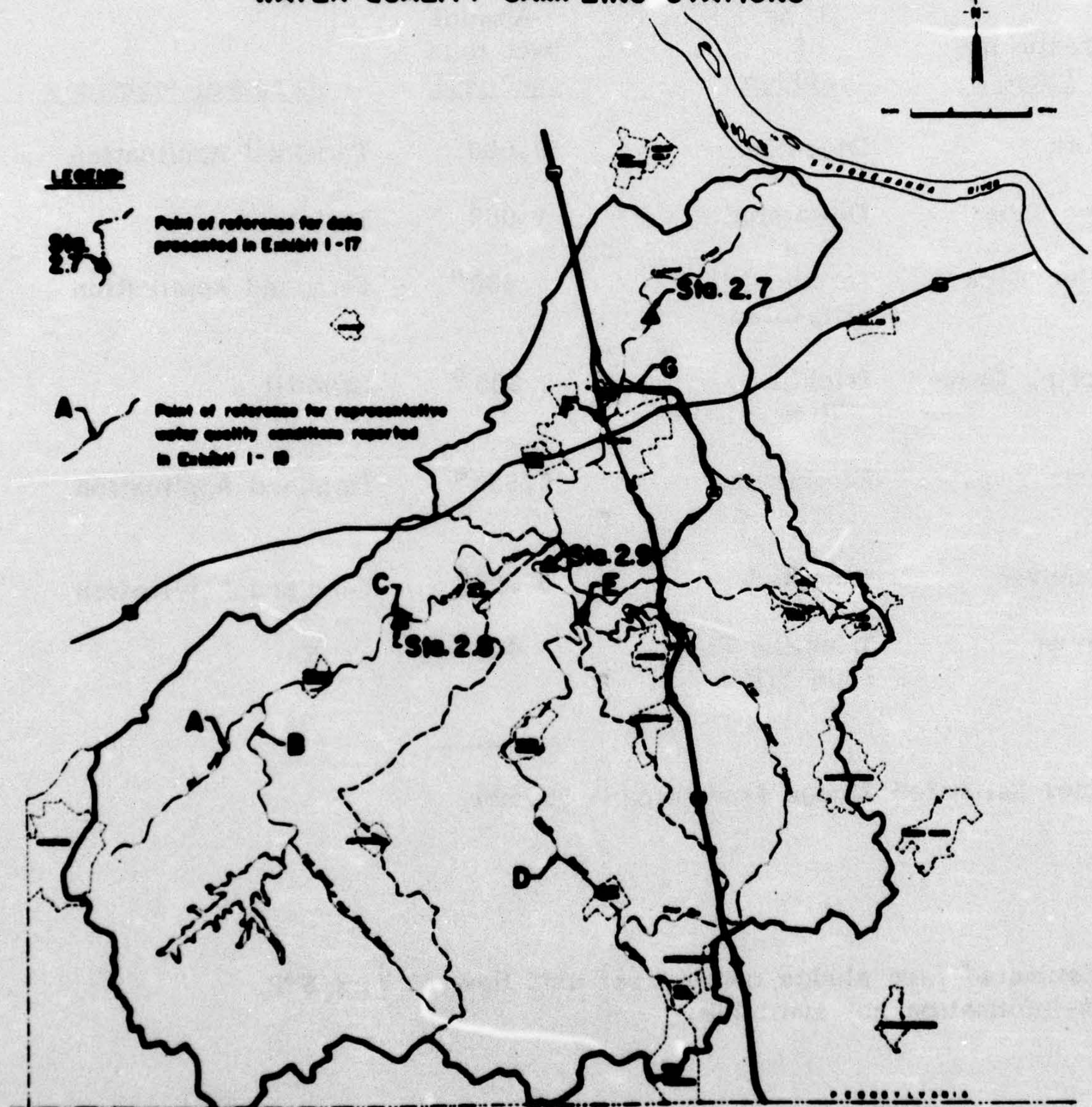
MUNICIPAL SLUDGE DISPOSAL PRACTICES

Treatment Plant	Type of Sludge	Annual Amount (wet tons per yr.)	Disposal Practices
York	Digested	50,000	Farmland Application
Red Lion	Dewatered	1,000	Incineration
Glen Rock	Aerobically Digested	400[a]	Farmland Application
Spring Grove	Trickling Filter	300[a]	Landfill
Penn Twp.	Aerobically Digested	2,600[a]	Farmland Application
Hanover	Digested	5,200[a]	Farmland Application
Dover	Trickling Filter Sand Filter	400[a]	NA
Total Estimated Sludge Production		59,900	

[a]Estimated from sludge content per unit flow at York STP.
NA-Information not available.

Exhibit I-16

CODORUS CREEK DRAINAGE BASIN
WATER QUALITY SAMPLING STATIONS



In the Codorus Basin, careful management of sludge application practices is imperative due to the presence of thin soil profiles and the problem of rapid overland flow of runoff to the streams during heavy rainfall conditions. Application practices, rates of application, locations, times, frequencies and post-application land cultivation procedures must be reexamined, improved as necessary, and enforced.

Industrial Sludge Disposal - The P. H. Glatfelter Paper Company, as a result of their integrated pulp and paper production on the Codorus West Branch, generate approximately 50 wet-tons/day of combined primary and secondary sludge from their wastewater treatment facility. The present method of sludge disposal is by thickening and accumulation in earthen lagoons at their extensive treatment facility near Spring Grove. Various alternative ultimate sludge disposal methods are being evaluated by the Company at this time. The Company considers sludge disposal their most difficult long-range environmental problem.

Industrial wastewater solids disposal by other industries in the Basin are not of significant extent to justify detailed discussion. The ultimate resolution of solids disposal or restoration to a resource is a problem that often interrelates with ground and surface water management, with air quality control and with urban aesthetics.

WATER QUALITY CONDITIONS

Community Views and Perceptions

Water quality in the Codorus Basin is perceived by the local citizenry primarily in terms of severe deficiencies in physical appearance - discoloration, turbidity, odor and insufficient flows. The existance of these easily perceived deficiencies for many years coupled with the absence of any expectation for improvements that would permit major changes in quality potential, have produced a public attitude that until recently has regarded the Creek as a liability. For example, the chronic public dissatisfaction with the overall water quality of Codorus Creek is reflected in editorial references to the "Inky-Stinky Codorus".

A number of local conservation and community service organizations have been working to accelerate programs to implement improved water quality and management in the Basin. One of these groups, the The Codorus Creek Watershed Association was created for this purpose.

Assessment of the potential for the revitalization of Codorus Creek through York has been reactivated in the Urban Restoration Program for the center of York. Planning and redevelopment officials view a restored Codorus Creek as a potential prime focus for this plan.

These groups were influential in achieving the selection by York County of the highest standards for water quality in the establishment of the Pennsylvania Intra-state water quality standards. They have also kept alive proposals for the development of major new recreational facilities on the Codorus at Indian Rock and through the City of York. Implementation of these proposals requires major improvement in water quality conditions and regional management of the Basin.

Physical, Chemical and Biological Conditions

Water quality conditions and changes in the Codorus Basin are defined by both the magnitude and location of waste discharges and the level of natural streamflow available to dilute the wastes that enter the system. As a result, water quality conditions are highly variable displaying seasonal and shorter period oscillations. The typical flow conditions of late summer establishes the most critical quality conditions.

Three water quality sampling stations of the Pennsylvania Water Quality Network have been established in the Codorus Basin (Exhibit I-16). Quarterly sampling data for a select group of parameters for the 1970-71 period are summarized in Exhibit I-17. Additional water quality data for these and other locations in the basin are available from a number of special basin surveys undertaken by the Pennsylvania Department of Health. Exhibit I-18 displays representative concentration of select quality parameters of significance based on the data obtained in these surveys.

[1]Aquatic Biology Investigation, June 1969
Nutrient Survey, Summer 1968
Industrial Wastes Survey, Fall 1970
Nutrient Survey, August 1969

EXHIBIT I-17

SUMMARY OF PENNSYLVANIA SURFACE WATER QUALITY NETWORK
DATA FOR CODORUS BASIN STATIONS (1970-1971 PERIOD)

	BOD mg/l	Suspended Solids mg/l	Color Pt-Co Units	Turbidity J C Units	Total Solids mg/l	Dissolved Oxygen mg/l	PO_4 as P	Total Coliform #/100 ml
CODORUS CREEK BELOW YORK STATION 2.7								
Average	4.4	45.7	78	21	359	8.4	0.521	342×10^3
Maximum	6.4	76	225	25	670	10.6	0.976	$1,609 \times 10^3$
Minimum	1.6	24	20	15	198	5.6	0.096	16×10^3
No. of Determinations	6	6	6	6	6	6	6	5
WEST BRANCH CODORUS CREEK STATION 2.8								
Average	5.7	45	225	25	626	6.8	0.10	677×10^3
Maximum	10.5	64	800	30	1,472	9.0	0.17	$1,609 \times 10^3$
Minimum	2.8	28	60	20	230	3.6	0.03	3.5×10^3
No. of Determinations	6	6	6	6	6	6	6	5
SOUTH BRANCH CODORUS CREEK STATION 2.9								
Average	4.1	26	11	12	132	10.6	0.022	8.64×10^3
Maximum	14.5	52	20	20	146	13.6	0.047	17.20×10^3
Minimum	1.1	10	0	5	114	8.8	0.003	0.5×10^3
No. of Determinations	6	6	6	6	6	6	6	5

EXHIBIT I-17 (Cont'd)

SUMMARY OF PENNSYLVANIA SURFACE WATER QUALITY NETWORK DATA FOR SUSQUEHANNA RIVER AT YORK CO. (1970-1971 PERIOD)

	BOD mg/l	Suspended Solids mg/l	Color Pt-Co Units	Turbidity JC Units	Total Solids mg/l	Dissolved Oxygen mg/l	PO_4 as P mg/l	Total Coliform #/100 ml
MARIETTA LANCASTER CO. STATION 2.1 (below Codorus Creek Confluence)								
Average	1.9	33	14	14	161	10.7	0.029	8.6×10^3
Maximum	3.6	68	20	25	188	11.2	0.083	12.6×10^3
Minimum	0.9	10	5	5	106	9.2	0.003	3.6×10^3
No. of Determinations	7	7	7	7	7	7	7	2
HARRISBURG DAUPHIN CO. WALNUT ST. BRIDGE STATION 2.2 (above Codorus Creek Confluence)								
Average	2.5	26	16	21	167	11	0.030	2.25×10^3
Maximum	6.6	76	25	70	259	13.1	0.113	7.0×10^3
Minimum	0.9	6	10	7	102	10.1	0.003	0.006×10^3
No. of Determinations	7	7	7	7	7	7	7	10

EXHIBIT I-18

REPRESENTATIVE WATER QUALITY CHARACTERISTICS OF CODORUS BASIN TRIBUTARIES

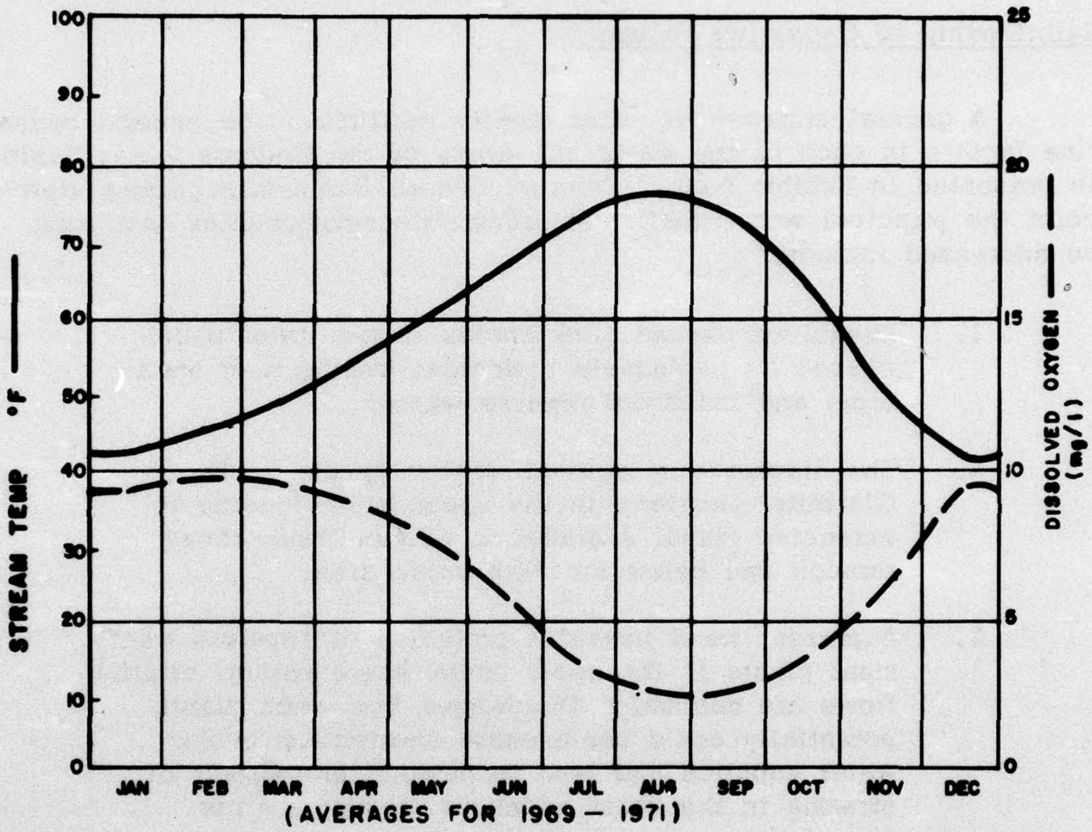
Place	Reference (Exhibit I-16)	BOD mg/l	Total Solids mg/l	Sus. Solids mg/l	PO_4 as P mg/l	Nitrogen as N: NO_3 mg/l	Nitrogen as N: NH_3 mg/l	Nitrogen as N: Org. N mg/l	Heavy Metals mg/l	Dis. Oxygen mg/l	Color Pt-Co Units	Turbidity 2 C Units
Oil Creek	A	5	400	40-120	0.2-1.5	0.3-1.5	0.3	1.1	0.6	5.3	-	20
West Branch above Oil Creek	B	-	-	-	0.03	0.7	-	0.1-0.6	-	-	-	-
West Branch below Glat-felter	C	6	625	45	0.1	0.6-1.9	0.6	-	0.01	6	225	20
South Branch below Glen Rock	D	3.7	200	60	0.1-0.2	0.9-1.4	.24	1.3	0.03	7.8	30	40
East Branch above South Branch Junction	E	1.3	200	40	-	0.7-1.5	-	1.2	-	7.7	20	-
Codorus Creek at York	F	2.5	560	80	0.1-0.2	0.3-1.5	0.2	0.5-2.6	0.2	5.4	150	20
Mill Creek	G	4	520	40-140	0.5-2.5	0.9-1.3	3.2	4.2-5.5	0.03	6	40	-

Note: (-) indicates not determined.

The principal quality problems as exemplified by the data given in these exhibits include:

BOD	High concentrations (greater than 4 mg/l) are present in the West Branch, the lower reaches of the South Branch (below Glen Rock), the entire Main Stem, Oil Creek, and Mill Creek.
Suspended Solids	High concentrations (greater than 40 mg/l) throughout most of the basin. Periodic major problems in Oil and Mill Creeks and in lower portions of principal branches during periods of heavy runoff.
Total Solids	West Branch below Spring Grove, Main Stem Oil Creek and Mill Creek experience concentrations (greater than 500 mg/l) that exceed State water quality objectives.
Color	The effluent from Glatfelter Paper Company produces average color levels of 225 units in the West Branch and 150 units in the Main Stem at York. These exceed the long range State objective of 50 units.
Phosphorus	Phosphorus concentrations (greater than .03 mg/l) sufficient to cause aquatic growths are present in the South and West Branches, in the Main Stem through York and downstream of York. High phosphorus levels are also evident in Oil and Mill Creeks.
Heavy Metals	Significant concentrations of heavy metals have been recorded in Oil Creek, Codorus Creek, at and below York, and in Poorhouse Run. These materials have been attributed to direct industrial discharges.
Dissolved Oxygen	Dissolved oxygen deficiencies are evident for Oil Creek, the West Branch below Spring Grove and the Main Stem of Codorus Creek through and below York. The seasonal cycle of typical dissolved oxygen levels in Codorus Creek below York is presented in Exhibit I-19.
Turbidity	A low level turbidity problem is continually present in the South and West Branches of the upper basin. Extremely high turbidity levels are periodically encountered in the South Branch at the York water intake and in the West Branch at Spring Grove during periods of heavy storm runoff.

Exhibit I-19



TYPICAL DISSOLVED OXYGEN — TEMPERATURE RELATIONSHIP FOR CODORUS CREEK DOWNSTREAM FROM YORK

Bacteriological — All lower reaches of the South and West Branches and the Main Stem through and below York experience coliform levels that are substantially higher than acceptable for full or partial body contact (1,000 to 5,000/100 ml). Coliform levels below the York STP are consistently extremely high.

Relationship to Causative Factors

A general summary of water quality conditions and general causative factors in each of the major sub-areas of the Codorus Creek Basin is presented in Exhibit I-20. From an overall Basin management viewpoint the principal water quality/environmental relationships that must be addressed include:

1. Dissolved oxygen deficiencies in the lower basin caused by inadequate biological treatment of municipal and industrial organic wastes.

2. The discharge of colored wastes by the P. H. Glatfelter Company in the upper basin leading to extensive visual degradation of the Creek above, through and below the York urban area.

3. A present trend toward a profusion of separate treatment plants in the upper basin where natural dilution flows are minimal. Discharges from such plants potentially could contaminate downstream public water supplies and lead to nutrient enrichment of streams in the Basin which at present are not degraded.

4. Projected future reductions in natural flows and increased wastewater discharges with expected area growth and increased usage of in-basin water supplies.

Certain of the above impact relationships are elaborated below:

Phosphorus Enrichment - The protection of the recreational pools of the Susquehanna River from excessive growth of aquatic plants is dependent upon the reduction of phosphorus discharges in the Codorus Basin. During the critical summer months, the amount of soluble phosphorus entering the Susquehanna from Codorus Creek, an average of 400 lbs/day, is equal to the amount in the Susquehanna just upstream from Codorus Creek. This indicates that much of the phosphorus is retained or utilized in the local pools along the Susquehanna River. Thus, local inflows from tributary basins are the main sources of available new soluble phosphorus required for augmented growth of aquatic plants. During the winter months, when aquatic growth is suspended, the soluble phosphorus is flushed down the river.

Stream Dilution Relationships - Exhibit I-21 shows the locations and average daily flows of municipal and industrial wastewater discharges in the Codorus Creek Basin. It also compares, graphically, the wastewater discharges with the minimum average monthly natural stream flows at three locations. The average minimum monthly flows represent the typical low flow conditions of late summer.

In both the West Branch and Main Stem of Codorus Creek, waste flows constitute a major component of the total stream flow. Less than a gallon of natural flow is available to dilute each gallon of effluent during typical low flow summer months.

Codorus Creek is subject to even lower natural flows during extreme drought years. Presently the minimum allowable natural discharge at Spring Grove is 4 cfs and 6 cfs must be released from the South Branch at the York Water Company intake. This compares to approximately the 10-year 7-day low flow condition. Under such conditions the total volume of waste discharges exceed dilution flow by a factor of three to one in the Main Stem below York. Effectively, virtually all flow is waste discharge.

Regional Development Impacts

Although many scenic and environmental amenities and potentials are present along Codorus Creek and its tributaries, very low utilization of the water resource is the general rule because of the extensive deterioration of water quality, particularly in the lower half of the Basin.

The main stem of Codorus Creek is a pronounced example of where recreational opportunities have been sacrified to a deteriorated

EXHIBIT I-20

SUMMARY OF EXISTING WATER QUALITY CONDITIONS

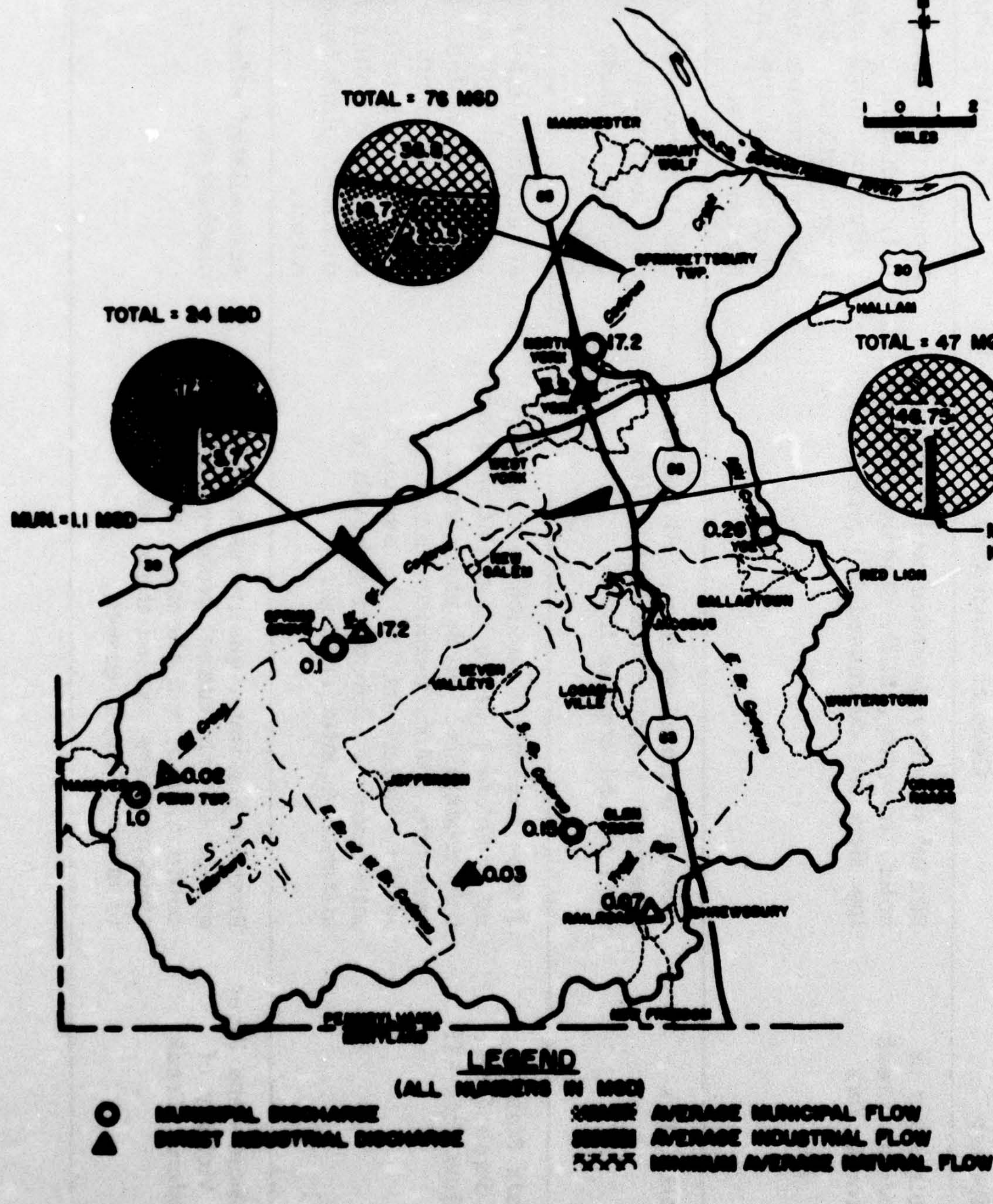
Tributary	General Conditions	Causative Factors
Oil Creek	Substantially degraded as evidenced by absence of pollution sensitive benthic organisms - high nutrient and BOD concentrations, significant heavy metals.	Penn Twp. STP discharges, Hanover area industrial discharge, agricultural and sediment runoff.
West Branch above Oil Creek	Slight nutrient enrichment - turbidity and coliform concentration in Lake Marburg	Land runoff
West Branch below Spring Grove	Severely degraded - most benthic organisms are pollution tolerant, elevated temperatures, depressed D.O. high BOD, high color and total solids, some nutrients. Does not meet present temperature, D.O. and color standards.	Primary source - Glatfelter Paper Co. discharge, Spring Grove STP discharge, some accumulation of upstream pollutants.
South Branch	Slightly, degraded in upper reaches (New Freedom to below Glen Rock) - pollution tolerant benthic organisms, some nutrient enrichment, some turbidity problems.	Glen Rock STP., Laundromat and septics at Railroad/New Freedom, agricultural and sediment runoff, stream banks not maintained to prevent erosion and streambed not kept free of debris.
East Branch	Stream generally in good condition.	No significant concentrated discharges.

EXHIBIT I-20 (Continued)

Tributary	General Conditions	Causative Factors
Main Stem of Codorus Creek through York	Stream severely degraded with nutrient, color, turbidity, BOD, dissolved solids, low flow and depressed DO problems.	Accumulation of upstream municipal, industrial and land runoff pollutional discharges. Reduced natural dilution flow due to water supply diversion upstream. Degradation due largely to West Branch flows.
Mill Creek	Heavily polluted stream - all benthic organisms pollution tolerant. High nutrient and organic input.	Red Lion municipal STP and individual industrial plant discharges. Significant likely effects of urban storm runoff.
Main Stem of Codorus Creek below York STP	Stream severely degraded as evidenced by complete absence of pollution sensitive organisms. High phosphorus, ammonia, color, turbidity, and BOD levels. Significant DO depression in late summer. Substantial growth of attached aquatic species.	Accumulated effect of upstream discharge and York municipal and industrial wastes. Low natural flow in summer months available for dilution. Periodic shock loads of organic and solids from sewage treatment plant bypasses and storm runoff.
Susquehanna River in Vicinity of Codorus Creek	River meets water quality standards except for intermittent problems with coliform, iron and phenol. Nutrient concentrations exceed those necessary to enhance algae growth.	Accumulated effect of upstream discharges.

Exhibit I-21

CODORUS CREEK DRAINAGE BASIN MAJOR WASTEWATER DISCHARGES COMPARED WITH NATURAL STREAM FLOWS DURING MINIMUM MONTH



water quality. It traverses the most populous area of the County, York and its suburbs. Yet little, if any, adjacent land use utilizes the Creek in any positive relationship. This is a considerable contrast from earlier times in York when the Codorus and its adjacent lands constituted a focal point for boating, swimming, picnicking or just plain strolling.

Prior to the development of the present water quality standards Codorus Creek had been managed primarily for two functional purposes:

1. Public and industrial water supply for a manufacturing region.

2. The conveyance of wastewater from the same industrial center.

Only within the past decade have major efforts been made to incorporate substantial recreational uses in the management objective. Codorus State Park centering around the multipurpose recreational use of Lake Marburg was developed. However, even with this major facility, the highest priority use of the Lake is for industrial water supply for the P. H. Glatfelter Company.

These past management objectives and resultant quality conditions have restricted recreational development of the Creek to the following activities and facilities which are located in the upper parts of the Basin.

1. Codorus State Park, with its newly developed water impoundment, supports a variety of boating activities and is designed to maintain a facultative fish population that should provide considerable recreation opportunity. The Commonwealth of Pennsylvania Bureau of Parks reports, however, that no swimming or full body contact water activities are permitted for a combination of reasons including beach maintenance difficulties together with water quality problems of turbidity and coliform bacteria. The Bureau of Parks is building separate, concrete pools with controlled water quality in order to provide swimming at the park.

2. The Codorus South Branch - sustains a reasonable fish population, but water quality problems limit both the number of fish and the quality of the fishing experience.

3. The Codorus East Branch and the East Branch of the Codorus West Branch - both sustain a cold water or trout fishery. These are the best quality waters in the basin and supply great recreational value to the angling population of the basin.

4. The York Water Company Impoundments - contain high quality water. These impoundments are managed primarily for water supply. Limited fishing is allowed, but no swimming or boating is permitted.

Special EPA Water Quality Survey

As part of this study Region III of the Federal Environmental Protection Agency (EPA) conducted a special field survey of the Codorus Creek Basin during the month of September 1971. The study was organized primarily to provide improved updated data for BOD - DO analyses and to assess the concentration and dynamics of nutrients discharged into the Basin.

A total of 18 surface water and 7 treatment plant sampling location were investigated. The parameters of analyses and the stations sampled are indicated in Exhibit I-22 and I-23, respectively. Exhibit I-24 shows the locations of the sampling points in the Basin.

The results of this survey for select parameters are presented in summary form in Exhibits I-25, I-26, and I-27. The following observations are made on the survey results.

1. BOD data were extremely erratic and questionable and therefore had to be excluded from analysis.

2. Dissolved oxygen results show consistent deficiencies in the West Branch below Glatfelter and in the Main Stem through and below York.

3. Color concentrations shown for the West Branch and Main Stem are substantially lower than expected. Survey results for this parameter are likely to be in error.

4. Heavy metals (chromium, copper and zinc) were consistently low (below 0.1 mg/l) throughout the basin. The only signficant source of heavy metals of the treatment plants sampled occurred at the York STP where zinc averaged 0.27 mg/l for five samples taken.

5. Nutrient discharges (phosphorus and ammonia) from treatment plants were significantly less (approximately half) than the expected levels.

6. Phosphorus concentrations exceed threshold problem potential levels (ortho-phosphorus greater than .03 mg/l) in all areas except the East Branch. High phosphorus levels ($\pm$ 1.0 mg/l) are present in the Main Stem, Mill Creek and Oil Creek. This is attributable to treatment plant discharges.

7. Ammonia levels in the Main Stem, in the West Branch below Glatfelter and in the upper reaches of Mill Creek (at 0.5 mg/l) are lower than expected. However, they are just at the threshold levels that may be injurious to aquatic life. Elsewhere ammonia levels are generally less than 0.1 mg/l.

8. Nitrification of ammonia and organic nitrogen to nitrate is evident in the Main Stem through York. This is shown by the increase in median nitrate nitrogen concentrations from 1.9 mg/l at COR 007 to 3.6 mg/l at COR 001, together with the drop in ammonia nitrogen over this same distance.

9. Results of the diurnal oxygen study (Exhibit I-28) evidence that significant photosynthetic activity (algae formation) occurs at most locations in the basin. During daylight hours photosynthetic activity predominates and generates excess oxygen which increases D.O. levels. During the nighttime hours when photosynthetic activity is absent the respiration of biologic organisms consumes oxygen and depletes the D.O. concentration.

   Significant diurnal fluctuations in D.O. levels is indicative of high levels of photosynthetic and biologic activity. For many of the stations sampled the ratio of maximum D.O./minimum D.O. over a 24-hour period exceeds 1.20.

EXHIBIT I-22

EPA WATER QUALITY SURVEY
ANALYSES PARAMETERS

Physical Parameters

- Color
- Turbidity
- Suspended Solids
- Total Solids

Chemical Parameters

- Total Organic Carbon (TOC)
- Chemical Oxygen Demand (COD)
- Biochemical Oxygen Demand (BOD)
- Chlorides
- Sulfates

Metals

Iron	Cadmium
Chromium	Lead
Copper	Aluminum
Zinc	Calcium
Manganese	Magnesium
Nickel	Mercury

Nutrients

- Total Kjeldahl Nitrogen (TKN)
- Nitrite (NO_2-N)
- Nitrate (NO_3-N)
- Ortho-Phosphorus
- Total Phosphorus
- Ammonia (NH_3-N)

EXHIBIT I-23

EPA WATER QUALITY SURVEY
FIELD SURVEY SAMPLING STATIONS

Surface Water Stations

Main Stem of Codorus Creek

COR 001	COR 007
COR 005	COR 014

West Branch of Codorus Creek

WCO 016	WCO 024
WCO 019	WCO 028
WCO 022	

South Branch of Codorus Creek

SCO 000	SCO 014
SCO 007	SCO 016

East Branch of Codorus Creek

ECO 000

Mill Creek

MIL 000	MIL 008

Oil Creek

OIL 000	OIL 005

Wastewater Treatment Plants

COR 005	Springettsbury S.T.P.
COR 009	York S.T.P.
WCO 025	P. H. Glatfelter T.P.
WCO 026	Spring Grove S.T.P.
SCO 015	Glen Rock S.T.P.
MIL 009	Red Lion S.T.P.
OIL 006	Penn Township S.T.P.

NOTE: Station numbers refer to mileage index.
See Exhibit I-25 for station locations.

Exhibit I-24

CODORUS CREEK DRAINAGE BASIN
SPECIAL EPA SURVEY SAMPLING STATIONS

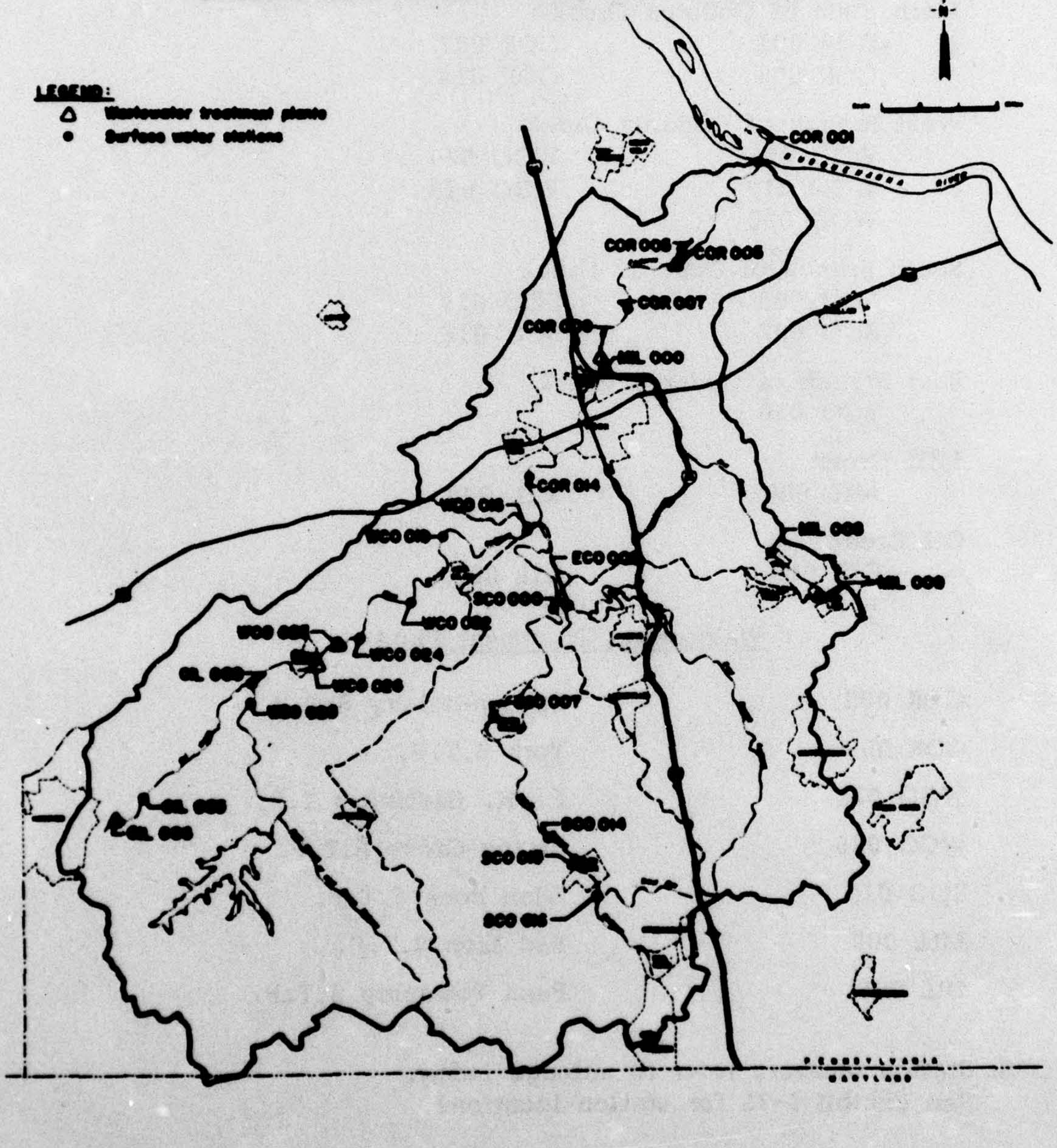


EXHIBIT I-25

EPA WATER QUALITY SURVEY
CHEMICAL AND PHYSICAL CHARACTERISTICS
MEDIAN VALUE CONCENTRATION FOR SAMPLES ANALYZED

SURFACE WATER STATIONS	COLOR	TURBIDITY	SUS.SOLIDS	TOT.SOLIDS	TOC	COD	CI.	SO_4	D.O
COR 001	37.5	17.0	26.5	385.5	22.0	35.0	76.5	37.0	5.36
COR 005	55.0	21.5	23.5	407.5	21.5	42.0	86.0	30.5	4.65
COR 007	42.5	22.0	26.5	411.0	26.0	47.0	80.5	30.5	4.83
COR 014	57.5	23.5	58.0	432.5	23.0	47.5	78.0	23.0	5.98
WCO 016	60.0	33.0	48.0	621.0	35.5	62.5	160.0	37.0	3.43
WCO 019	45.0	33.5	59.5	572.0	38.0	59.0	170.0	44.0	3.07
WCO 022	50.0	35.0	71.0	627.5	48.5	61.5	185.0	45.5	2.83
WCO 024	57.5	34.0	55.5	709.0	41.5	72.5	210.0	48.5	2.31
WCO 028	15.0	10.0	14.5	88.5	8.5	9.5	7.5	11.0	9.24
SCO 000	20.0	12.5	14.5		10.5	10.0	11.0	10.5	7.53
SCO 007	10.0	6.5	4.5	48.5	3.0	7.0	8.0	8.0	9.15
SCO 014	10.0	4.5	11.0	59.0	4.0	5.5	8.0	8.0	9.39
SCO 016	9.0	4.3	8.0	140.0	5.5	6.0	10.0	8.5	9.43
ECO 000	9.0	5.5	16.0	124.0	7.0	12.5	14.0	9.0	7.40
MIL 000	7.5	4.0	20.8	323.0	6.5	8.5	36.0	37.0	8.47
MIL 008	8.5	3.5	12.0	192.5	6.5	13.0	28.5	17.0	7.29
OIL 000	17.5	9.0	12.5	255.5	9.0	14.0	34.5	32.5	9.38
OIL 005	27.5	22.5	32.8	387.5	19.5	24.0	58.0	47.5	5.41

WASTEWATER TREATMENT PLANTS	COLOR	TURBIDITY	SUS.SOLIDS	TOT.SOLIDS	TOC	COD	CI.	SO_4	D.O
COR 005	25.0	7.0	15.6	354.0	18.0	34.0	34.0	65.5	-
COR 009	40.0	36.0	42.0	410.0	50.0	130.0	47.5	76.0	-
WCO 025	45.0	22.0	28.0	1238.0	79.5	165.0	460.0	101.0	-
WCO 026	47.5	21.5	29.2	332.0	38.5	66.0	41.0	37.0	-
SCO 015	30.0	7.0	18.5	270.0	17.0	35.5	35.0	26.0	-
MIL 009	35.0	8.0	13.8	340.0	25.0	53.0	54.0	41.0	-
OIL 006	20.0	4.3	7.0	546.5	18.5	33.0	43.5	53.5	-

NOTE: All concentration in mg/l except as follows:
Color - Pt-Co units Turbidity - Jackson Turbidity Units (JTU)

EXHIBIT I-26

EPA WATER QUALITY SURVEY
NUTRIENT CHARACTERISTICS
MEDIAN VALUE CONCENTRATION FOR SAMPLES ANALYZED
(Concentrations in mg/l)

SURFACE WATER STATIONS	ORG.N	NH_3 as N	NO_2 as N	NO_3 as N	TOTAL N	ORTHO-PHOS.	TOTAL PHOS.
COR 001	1.51	0.51	0.20	3.1	5.31	0.53	1.04
COR 007	1.67	0.59	0.11	1.9	4.27	0.55	0.9
WCO 019	1.71	0.53	0.13	1.9	2.03	0.06	0.23
WCO 024	2.23	0.85	0.12	1.3	4.5	0.05	0.30
WCO 028	1.17	0.04	0.04	1.6	2.85	0.48	0.54
SCO 000	0.55	0.01	0.01	1.85	2.42	0.03	0.07
SCO 014	0.42	0.001	0.01	1.6	2.03	0.08	0.13
ECO 000	0.90	0.08	0.02	1.3	2.33	0.01	0.04
MIL 000	0.79	0.05	0.11	4.6	5.55	0.63	0.76
MIL 008	1.17	0.65	0.44	7.4	9.66	3.5	4.2
OIL 000	1.01	0.11	0.07	2.8	3.99	0.58	0.75

WASTEWATER TREATMENT PLANTS		ORG.N	NH_3 as N	NO_2 as N	NO_3 as N	TOTAL N	ORTHO-PHOS.	TOTAL PHOS.
Springettsbury	COR 005	6.77	2.78	0.37	0.52	10.44	2.0	2.75
York	COR 009	11.92	3.78	0.25	0.57	16.52	4.2	7.9
P.H.Glatfelter	WCO 025	4.20	3.81	0.04	0.49	8.54	0.04	0.17
Spring Grove	WCO 026	5.27	3.13	0.03	5.5	13.93	5.0	10.0
Glen Rock	SCO 015	1.68	2.52	0.07	7.4	11.67	8.1	9.4
Red Lion	MIL 009	15.07	2.83	0.17	4.0	22.07	14.0	14.0
Penn Twp.	OIL 006	3.82	0.10	0.01	0.24	4.17	2.6	9.3

EXHIBIT I-27

EPA WATER QUALITY SURVEY
DIURNAL OXYGEN CHANGES
(Concentrations in mg/l)

STATION	DATE	D.O. (MAX.)	D.O. (MIN.)	RATIO (MAX./MIN.)	TIME OF MAX.
COR 001	9/9/71	5.87	5.02	1.17	1545
COR 005	9/9/71	5.17	3.45	1.50	1357
COR 007	9/15/71	5.34	4.41	1.21	2005
COR 014	9/21/71	7.15	6.14	1.16	2010
WCO 016	9/9/71	4.45	3.40	1.31	1755
WCO 019	9/9/71	4.31	3.48	1.24	1155
WCO 022	9/15/71	3.63	3.02	1.20	0830
WCO 024	9/15/71	4.57	3.24	1.41	2030
WCO 028	9/9/71	10.09	9.19	1.10	1400
SCO 000	9/21/71	7.92	6.94	1.14	2000
SCO 007	9/21/71	8.31	6.90	1.20	1405
SCO 014	9/21/71	8.35	7.46	1.12	0802
SCO 016	9/21/71	9.54	8.07	1.18	1545
ECO 000	9/21/71	8.14	7.50	1.09	1150
MIL 000	9/15/71	9.67	8.20	1.18	1755
OIL 000	9/9/71	12.74	5.03	2.53	1415

TYPICAL TIMES OF DIURNAL OBSERVATION: 0600, 0800, 1000, 1200, 1400, 1600, 1800, 2000